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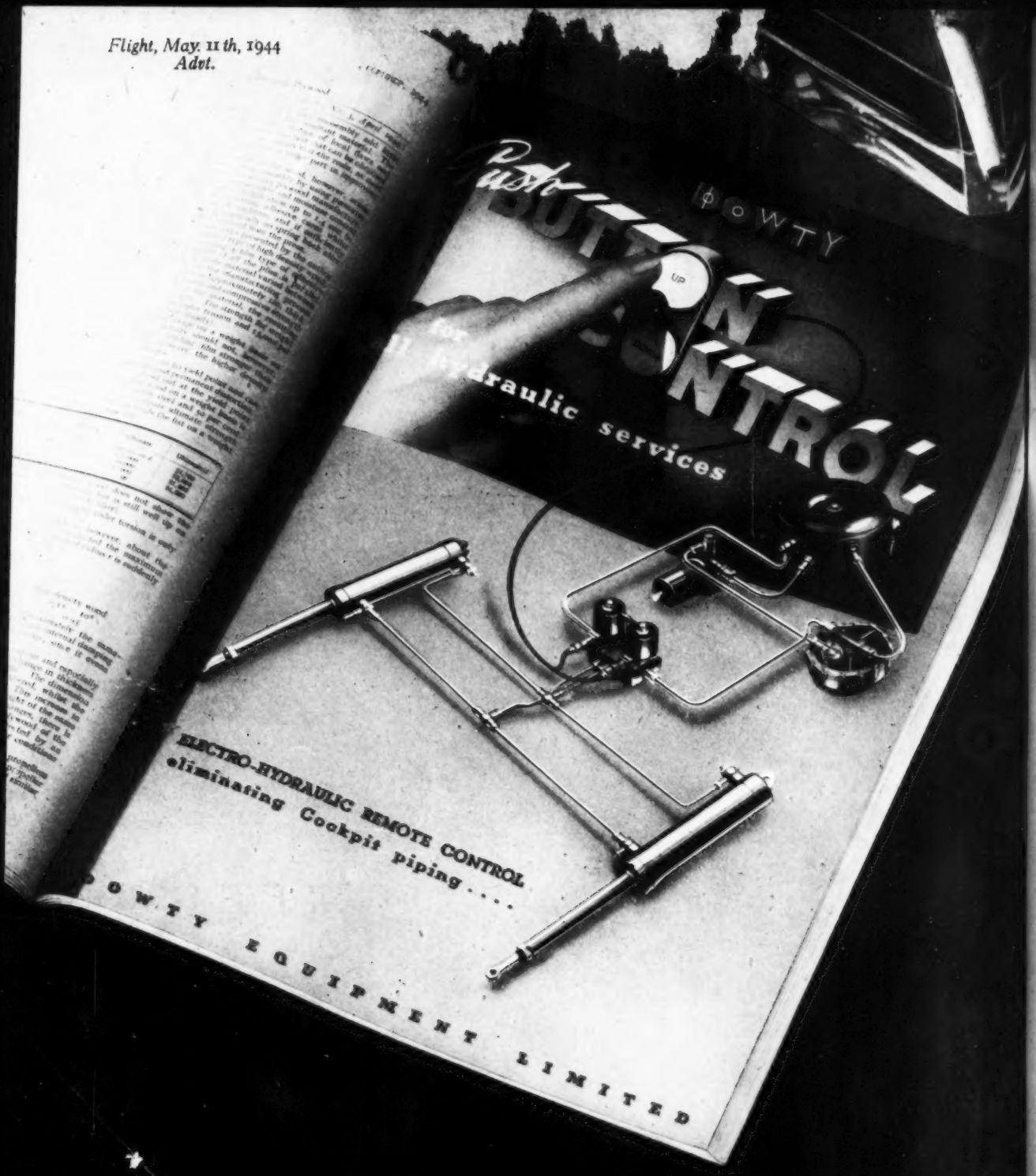

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FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

COVENTRY: 8-10, CORPORATION ST. Telegrams: Autocar, Coventry. Telephone: Coventry 5210.
BIRMINGHAM, 2: GUILDHALL BUILDINGS, NAVIGATION ST. Telegrams: Autopress, Birmingham. Telephone: Midland 2971 (5 lines).
MANCHESTER, 3: 260, DEANSGATE Telegrams: Iliffe Manchester. Telephone: Blackfriars 4412.
GLASGOW, C.2: 26B, RENFIELD ST. Telegrams: Iliffe, Glasgow. Telephone: Central 4857.

Registered at the G.P.O. as a Newspaper.

No. 1846. Vol. XLV. May 11th, 1944. Thursdays, One Shilling

The Outlook

Hamstringing German Reserves

THE recent statement by a spokesman of the Ministry of Economic Warfare on the results of the bombing in France and Belgium is very comforting. The railway systems in those two countries, he said, could not carry the peak load necessary for the Germans to repel an invasion. The bombing of railways, we all know, is a short-term policy. Given labour and materials, each area of damage can be put in order in a comparatively short time. But at a critical moment when an invasion is imminent, that short time may well be of vital importance. In modern warfare the movement of troops and equipment depends largely on railways. During the crisis the production centres can safely be left to their own devices. They may be able to turn out the goods and even move them up to distributing centres and depots, but if the goods cannot get from there to the firing line they are for the time being of no importance. The critical time, of course, is while the invaders are getting ashore and establishing their beachheads. After they have made good that first all-important step then other considerations will again come into the picture.

Some Germans have been expressing surprise that the Allied bombers have done no battering of the defence lines along the coast between Norway and the Bay of Biscay. The civilian observer can make no confident guesses at the reason for that fact. It might be that such an operation would be thought to give the enemy a clue as to where the invaders intend to land; but on the other hand deceptive feints would be so easy that he could draw no certain conclusions from it. It is more probable that aircraft can do more good by hitting at communications just now, leaving the coast fortifications to be dealt with by guns, first of the Navy and later of the Army. Shells may be more effective than bombs in destroying prepared fortifications. It is very important not to waste or to misapply air power; and before the landings its best contribution is to strike at targets beyond the reach of the guns, and to immobilise the reserves of the German Army.

The Immediate Targets

AT the moment of writing no private person in this country knows whether the invasion of the Continent will have started by the time these words are published. The recent use made of air power by the Allied forces in Britain shows (if such a demonstration were needed) that the great moment will not be long delayed.

Attacks on German production have not been discontinued of late, but the heavy bombers of Sir Arthur Harris and General Spaatz have combined with the Second Tactical Air Force and the U.S. Army Ninth Air Force, which form Sir Trafford Leigh-Mallory's invasion air force, in paying attention chiefly to centres of communication on the Continent which are likely to be of use to the Germans in moving their reserves to the vital points. At the same time the U.S. Army Fifteenth Air Force in the Mediterranean (which is also part of the command of General Spaatz) and the heavy bombers under General Eaker (which are part of the Mediterranean Air Force), together with the medium bombers in Italy have been concentrating their attention on railway centres in Italy. The war is all one, and there may be an Allied landing on some part of the northern coast of the Mediterranean, which would call for the movement of German divisions from Italy to meet it.

While the various Air Forces have been thus engaged, it is significant that both the Russians and the Allies in Italy have been holding their hands. It is easy

for even the civilian observer to realise that once the invasion or invasions start, and everything depends on the ability of the Germans to rush reserves up to the places where they need them, offensives in Russia and Italy will promise success at a lower cost than recently had to be paid for every advance.

One Every Four Minutes

JUST why it should have been left for the First Lord of the Admiralty, head of the "Silent Service," to give to the world figures of Allied aircraft production is not immediately obvious, nor does is matter very much. The main thing is that Mr. Alexander did, in his Sheffield speech last Sunday, reveal the almost fantastic level which Great Britain, the rest of the Empire and the United States have reached. Between them these countries produced no fewer than 127,000 aircraft. As Mr. Alexander pointed out, this represents 14.5 aircraft every hour of the 24 hours. Even that does not give a true picture because few aircraft factories are working three shifts, so that the actual output is probably nearer twice that figure.

By comparison, Great Britain's average output of 2½ aircraft every hour since the war began looks rather insignificant. It is worth bearing in mind, however, that during the first year of war our output was very small indeed, especially bomber production. Obviously, therefore, our present rate of output is very much greater.

Those with a fondness for arithmetic may be able to make some pretty shrewd guesses as to present rate of output if they bear in mind that in March Mr. Oliver Lyttelton announced that in the British Isles we produced, from the beginning of the war to the end of 1943, 90,000 aircraft. He also stated that during 1943 75 per cent. of the total structure weight of aircraft for the R.A.F. and Fleet Air Arm was produced in this country, 6 per cent. by the rest of the Empire, and 18 per cent. by America.

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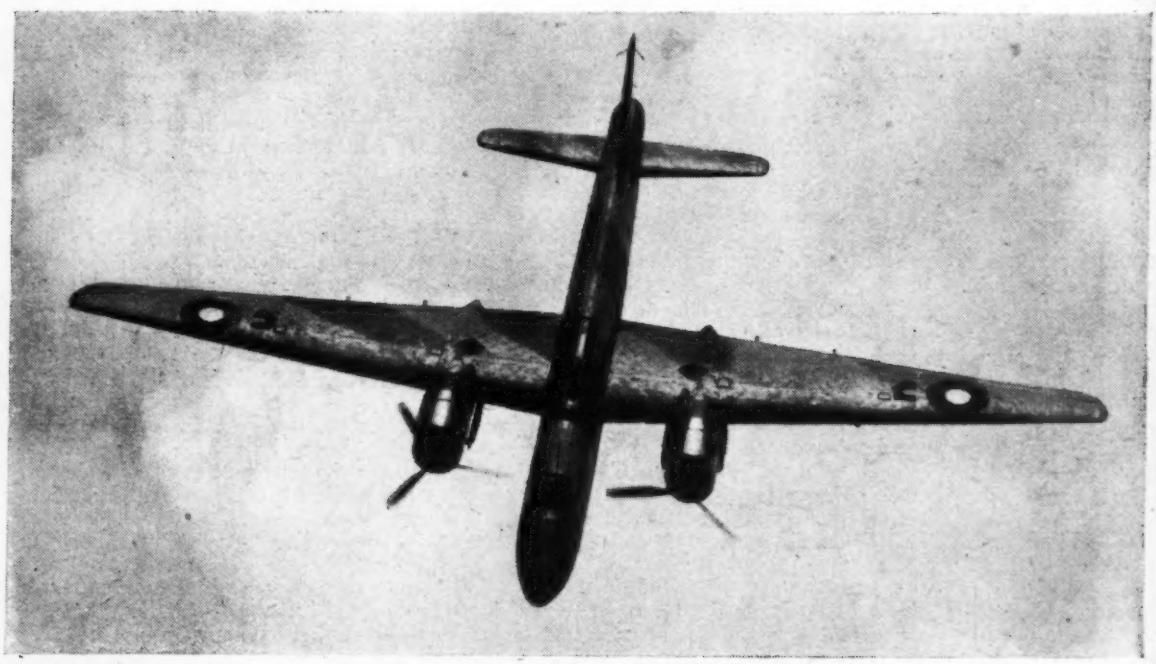
Doubtless Mr. Alexander was well aware that German statisticians will make the fullest use of his figures. It is a comforting thought that we have reached the stage when it does not matter if they do.

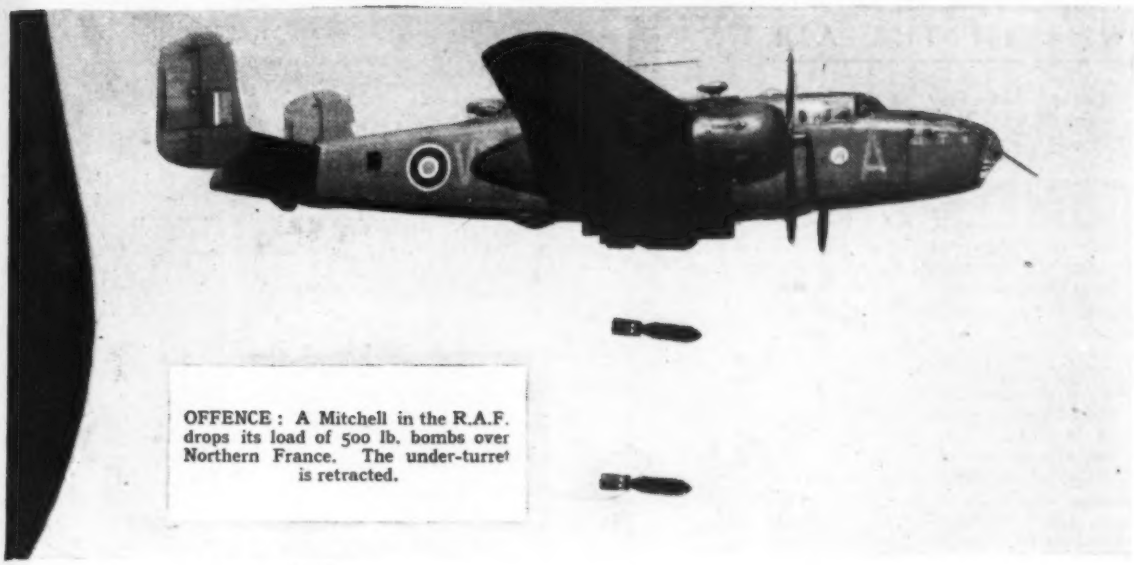
The Final Blow

EARLIER in the war Admiral Sir Andrew Cunningham said that the war would be won by the foot-slogging infantryman in his thousands, and this statement was in the nature of a concession by a sailor speaking of a sister Service. Last Saturday Mr. Oliver Lyttelton, a civilian Minister, said that the Army alone could finally win a war.

The opinions of both sailor and civilian may be accepted; but when one says "Army" in these days one must certainly be understood to include the contribution which will be made by the air. Foot-slogging infantry can no more win a final victory without air support than without artillery support. The British Army has not got a special air arm, but the successor of the old R.F.C. is a Tactical Air Force, wearing Air Force blue, but devoted to the task of making possible the final victory of the infantry.



SHAPELINESS: As the new Vickers Warwick transport passes below the photographer's aircraft the elegant plan form, strongly resembling the Wellington and Wellesley, becomes apparent.



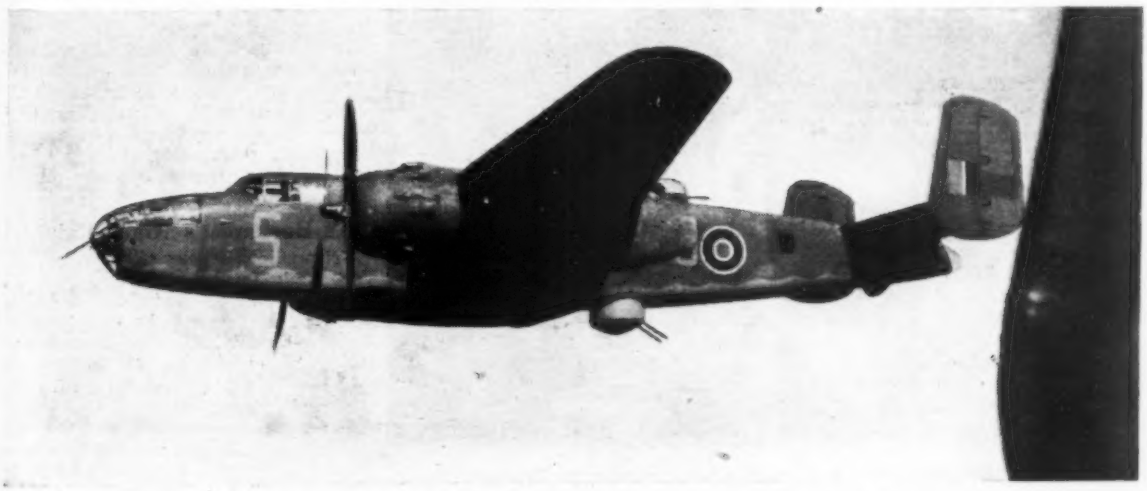
OFFENCE : A Mitchell in the R.A.F. drops its load of 500 lb. bombs over Northern France. The under-turret is retracted.

WAR in the AIR

Pin-pointing by the R.A.F. : Real Help for Tito : U.S. Naval Air Strength Growing : New Intruder Record

THE Americans have made a great reputation for themselves with their accurate pin-point day bombing. Since the introduction of the Pathfinder force, the R.A.F. night-bombers have also achieved a much greater degree of accuracy than they could boast when they first adopted the policy of area bombing—which was, in effect, a confession that, for a time at least, great accuracy could not be attained at night. The liquidation by six Mosquitoes of an important individual house at The Hague was a welcome demonstration that on occasions the R.A.F. can also pin-point with remarkable accuracy. It is, however, only fair to confess that this feat was not on the same footing as the bombing of the Fortresses and Liberators, because they aim from a great height, whereas the Mosquitoes came at their target at house-top level, and the leader confessed that he was in some anxiety as to whether his wings would clear the Peace Palace, whose builders cannot have expected that it would ever be so nearly concerned in warlike operations.

The bomb-aiming was probably a fairly simple matter, though the speed of the Mosquitoes would make it somewhat less carefree than was the low-level bombing which crowds at Hendon used to enjoy in the good old days of R.A.F. displays. This feat was less remarkable for the accuracy with which the building was hit than for the skill with which damage to other buildings (probably occupied by Dutchmen) was avoided, and also for the success with which the raiders concealed their purpose from the Germans until it was too late for the latter to take any steps to defeat the object of the raid. The house, it was known, contained large quantities of documents of great importance to the



DEFENCE : With the two-gun under-turret in action the North American Mitchell is almost devoid of blind spots

WAR IN THE AIR

Germans, but they could hardly suspect that the R.A.F. was aware of that fact. Steps had to be taken to see that if anything went wrong the Germans should be left in ignorance of the British knowledge about this, so that a second attack might be made before the enemy saw the necessity of moving the documents elsewhere.

The tactics were so skilful that every object was achieved. True, one bomb went astray and might have hit a house with Dutchmen in it. But fortune favoured good organisation (as the saying goes) and that bomb hit a German barracks, which it was hoped was full of German soldiers at the time. The important house was completely destroyed, and with it went the documents inside. Incendiaries accompanied the H.E. bombs, and they would make sure that the destruction of the papers was complete. It was a really good piece of planned bombing.

Help for Tito

ONE of the marvels of the present war is the way in which the Yugoslav partisans have held out against the Germans and won so many successes with such an exiguous supply of weapons. They got some modern equipment from the Italian troops when Italy ceased to fight on the side of Germany, but it cannot have been nearly enough. Above all, the Yugoslavs had no air arm. The drawback of this was minimised to some extent because most of the fighting has been in the mountains, where aircraft are somewhat less vital than over plains; but none the less one remembers that the small number of squadrons which the R.A.F. was able to send to help the Greeks during the campaign in Albania made a lot of difference to our gallant Allies.

Since the Anglo-American forces obtained control of the Foggia airfields in Italy, their aircraft have devoted a good deal of attention to holding out a helping hand to Tito and his heroes. Their bombing, however, must have been rather of a strategic nature. The intimate co-operation between ground troops and a tactical air force, which is so very desirable, was hardly possible when the aircraft were based in another country and were flown by foreigners who could not speak the language of the patriots.

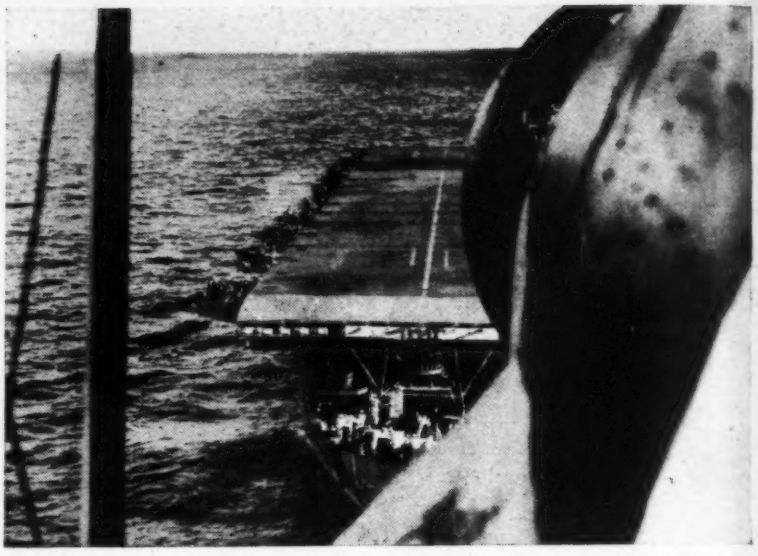
This is being remedied by raising a native Yugoslav Air Force, and pilots and ground crews are now being trained by R.A.F. instructors in Africa. There must have been some difficulty in finding instructors who could speak the language of the pupils, but evidently the difficulty has been surmounted somehow or other.

Another U.S. Navy aircraft carrier of 27,000 tons, named *Bon Homme Richard*, has been launched in New York. She is to have a speed of over 30 knots and will carry over 80 aircraft.

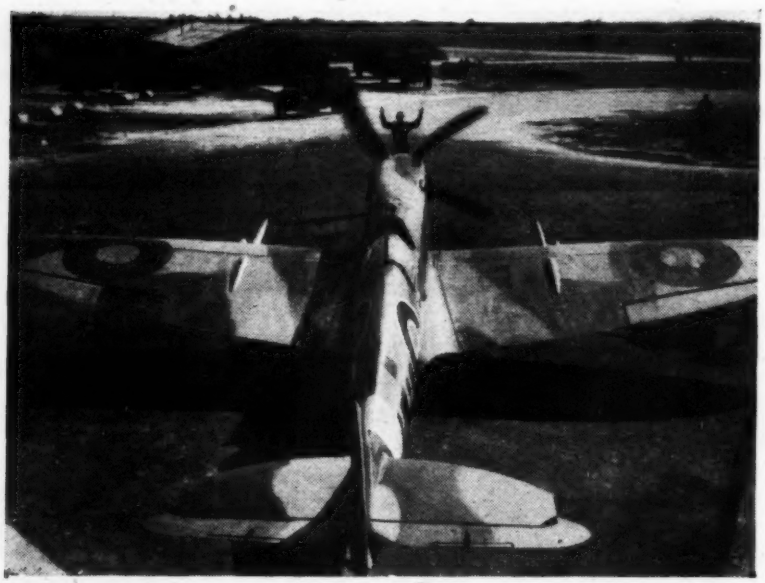
In New Guinea, Allied naval and air operations are steadily reducing the beleaguered Japanese. The Wewak area has been subjected to almost constant air attacks, and enemy fuel dumps and vehicles are constantly hit. The naval forces, in particular, have been sinking numbers of Japanese barges off the coast, and aircraft have added their quota to the sum total of this good work.

Bucharest's Night Raid

IN previous articles allusion has been made to the acute disruption of ordered life in Bucharest since the Americans began to bomb its railway centre by daylight. Rumanian administration broke down, and the Germans had to take over. Last week the distracted city had the novel (and doubtless very unpleasant) experience of a visit by night by R.A.F. Halifaxes, Liberators and Wellingtons. Again the railway yards were the target. Of late the R.A.F. has greatly improved the



LANDING-ON: A vivid impression from a Swordfish as it straightens up for the final approach to H.M.S. *Biter*. For quite a while the ship is blotted out by the nose of the aircraft. Landing-on has been likened to landing an aircraft on an invisible matchbox which is running away from you at 30 knots.



ACHTUNG SCHPITFEUER!: A Spitfire IX goes on a sortie over Germany. It's a far cry to the days of the Battle of Britain when this alarm was heard so often over the *Luftwaffe* radio. It is now being heard over Germany.

WAR IN THE AIR

accuracy of its night bombing, thanks chiefly to the work of the Pathfinders, and few bombs go astray to do damage outside the target area. None the less, one can imagine the dismay of the remaining inhabitants of the Rumanian capital. Londoners know how disturbing night raids can be; but whereas the Germans have scattered bombs widespread over London, hoping rather than fearing that they would kill civilians, the people of Bucharest were not subjected to that brutality. As a centre of German military communications, the place must now be of very diminished importance.

It was in December, 1940, when the German "blitz" over Britain was at its height, that the R.A.F. began to send night-fighters to intrude over German-held airfields and to shoot down enemy bombers as they took off or returned to base after the raid. In those days the airfields concerned were near to the Channel coast. Nowadays Mosquitoes intrude by night for over 500 miles from their home base, and last week one of them put up a new record by shooting down four enemy machines in the neighbourhood of Munich. The enemy in those parts does not seem even yet to have realised how long is the arm of the R.A.F., for the Mosquito's first victim was taking part in a night exercise, and was illuminated by an obliging German searchlight. The second was heading for an airfield which had all its lights blazing, and that also was an easy victim. Then two Fw 190s were found, flying in formation, and both were shot down, but the wreckage of one caused the Mosquito to stall, and the pilot only regained control when it was no more than 100 feet from the ground. Soon the Germans must begin to realise that none of their military installations is now really safe from the attentions of Allied aircraft.

ONE UP TO COASTAL COMMAND
The mass of water thrown into the air as a torpedo hits a German escort vessel off the Frisian Islands

HUMAN BULLDOZERS: Chinese labourers constructing an airfield in China. It is still more economical to use manpower instead of mechanisation in the East

Preparation

ALL last week and over the week-end the United Nations kept up the long-sustained bombing of railway centres, airfields, and aircraft factories behind the German lines. Everybody, including the Germans, regarded this as the preliminary to the landing of invasion troops in the West.

For the time being the destruction of enemy production centres became of secondary importance. In this connection it is interesting to note the agreement with Spain which cuts off a major source of the supply of wolfram from Germany. The export of quite a fair amount during June and July was agreed to by Britain, but nobody was much disturbed by the thought that Germany would be able to use the imports of those months for the production of any substantial quantity of hard steel. The belief was general that the war would have entered on a new phase by then, which would practically nullify the concession. Had this diplomatic victory been scored earlier, it might well have relieved Bomber Command of many of its anxieties. If it is good work to destroy enemy material in the factories before it can get to the fighting forces of the enemy, it is still more satisfactory to prevent it from even reaching the factories.

As blows at enemy mobility took first precedence during last week over attacks on production, one may ask what was the purpose of the Americans in sending their heavy bombers to Berlin last Sunday. The answer almost certainly is that they wanted to provoke the German fighters to combat. This desire was not gratified, for there was no opposition except from *flak*. One division of the heavy bombers reported sighting enemy fighters, but the latter avoided combat. A small force of Liberators of the 8th Air Force which attacked targets in Belgium the same evening had a similar tale to tell. The Germans declined to be drawn, and kept their fighters aground.

The lull in land fighting in both Italy and Russia also marked expectations of the opening of the operations in the West. No doubt Marshal Zhukov and Gen. Alexander used the time to bring up supplies and additional troops to convenient points, and rested the divisions which had been fighting so strenuously last month. Outer lines can give an advantage if simultaneous attacks can be delivered from many sides, and especially if the enemy's power of moving his reserves about quickly and easily has been largely cut down by the destruction of his centres of communications.

The case of Sevastopol may stand by itself. It is a very strong fortress, and to storm it must be a sanguinary affair, as the Germans found when they captured it. So the Russians merely bomb the fortifications, and use their Black Sea Fleet and aircraft to sink the ships which the Germans try to get away to Rumania.

Lvov, however, is an important railway junction and Red bombers attacked it repeatedly. It is to be hoped that they did crippling damage to its railway yards and stations.

HERE AND THERE

Canadian Contribution

BY the end of April, 100,000 air crews had been trained in Canada under the Commonwealth Air Training Plan. During 1943, 39,000 air crews were trained, and the total for the present year is estimated to reach 41,600.

Another Honour for Whittle

THE James Alfred Ewing Medal for 1943, awarded annually for specially meritorious contributions to engineering research, has been bestowed upon Group Capt. Frank Whittle, C.B.E., by the Council of the Institution of Civil Engineers.

Inaugural Meeting

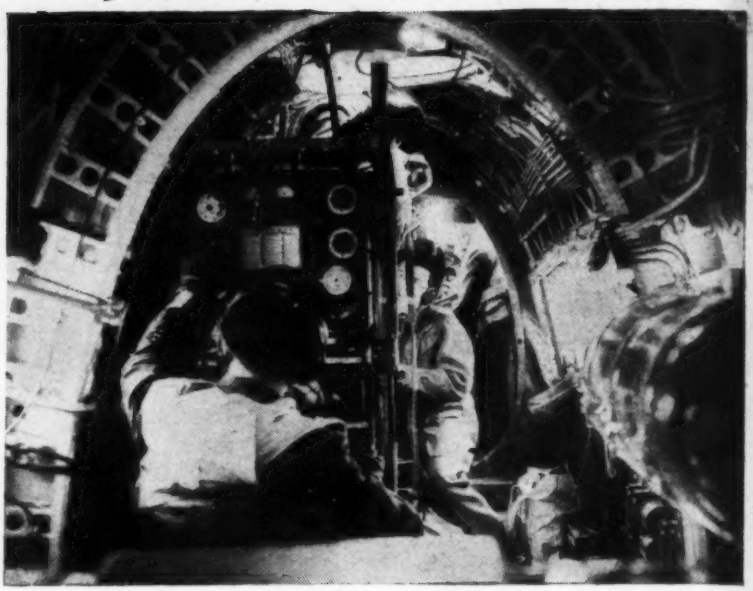
WHEN the newly formed Derby branch of the R.Ae.S. held its inaugural meeting recently, the speaker was Mr. Peter Masefield; his subject was "American Aircraft."

Mr. A. F. Sidgreaves is chief patron of the new branch, Mr. E. W. Hines is president, and already there are 350 members and candidates for membership.

Pre-war Address

THE Director-General and the administrative branches of the Department of Civil Aviation of the Air Ministry gave up its quarters at Parliament Square House yesterday and returned to its pre-war home in Ariel House.

The operational services and Intelligence Division are now located at Houghton House Annexe.

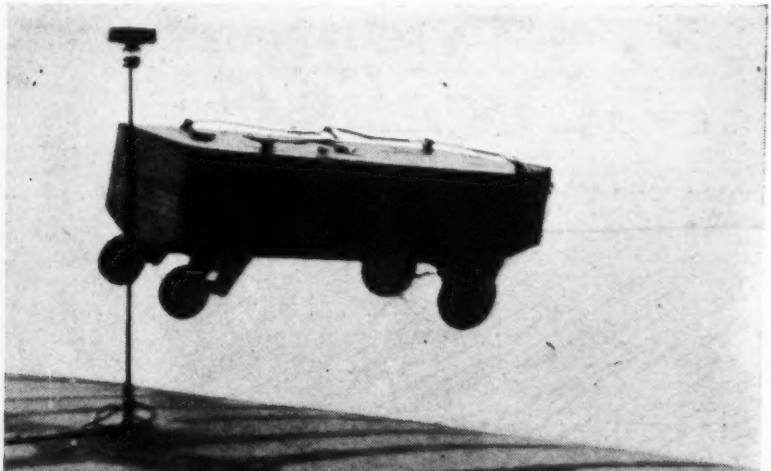


WARWICK H.Q.: A glimpse into the business quarters of the Vickers Warwick transport. Beyond the wireless operator's imposing panel can be seen the navigator and another member of the crew beneath the astro-dome, while the "second dickey" is for'ard to starboard. The famous geodetics are clearly visible.

Golden Gift for R.A.F.

IN making a gift of 300 ounces of gold as a tribute to the R.A.F., Haile Selassie, Emperor of Abyssinia, asked that it should be used for the benefit of the wounded and disabled.

In reply, the Air Minister, Sir Archibald Sinclair, said that he would entrust it to the R.A.F. Benevolent Fund, when it would be allocated to those who had suffered wounds in the fight for freedom and justice.



FLYING FLOSSIE: This is the Navy's name for the curious "aircraft" (what a wing-loading!) seen making a perfect take-off. It is a steel water-tank on wheels used for testing warships' catapult launching gear.

Chance for Young Artist

A VACANCY exists in our technical artists' department for a junior assistant. Applicants, who should reside in the London district, should write to the Managing Editor.

Dunlop Director Honoured

THE Colwyn Gold Medal has been awarded by the Institution of the Rubber Industry to Mr. A. Healey, B.Sc., a director of the Dunlop Rubber Co., Ltd., for conspicuous services in connection with the technique of tyre manufacture. Mr. Healey is adviser on synthetic rubber usage to the Ministry of Supply.

Helicopter Airports

NEW YORK CITY merchants are to hold a conference in June, says a message from Washington, at which they will discuss with designers and builders of helicopters how post-war out-of-town buildings can be planned to serve as helicopter "airports" after the war.

The merchants, it is stated, hope to encourage their customers to "jump over congested street traffic" and land on flat shop roofs in the city.

Spitfires from Beirut

BEIRUT hopes to present the R.A.F. with six Spitfires, and a "Spitfire Show Day" was scheduled to be held in the town last Saturday, presumably to give the project an official send-off and stimulate local interest.

The Lebanese Government, the municipality of Beirut, and the Hippodrome Society are each to provide one aircraft, the other three being paid for by various subscriptions.

100-octane Fuel Output

U.S. petroleum producers have increased their output of 100-octane petrol ten-fold since October, 1941, and

HERE AND THERE

production is now at the rate of 400,000 barrels a day. This was revealed recently by Mr. Harold L. Ickes, U.S. Secretary of the Interior, at a Press conference.

The programme for the construction of the special plant needed, 85 per cent. of which is completed, involves an expenditure of $100,000,000 (about £25,000,000), and the remaining authorised units are expected to be in action by the end of the present year.

Old Soldiers Never Die

VETERAN of the Boer War and the 1914-18 War, Aircraftman J. W. Jelfs, of Coalpit Heath, near Bristol, claims to be the oldest member of the R.A.F. He is 69.

When he first tried to enlist, in 1940, he was told he was too old, but after badgering the authorities with unrelenting persistence and even offering to pay for his own "medical," the R.A.F. finally decided that such determination ought not to be wasted, and accepted him.

Any grandpa want to challenge his claim?

Looking Well Ahead

IN a recorded address to the Silver Jubilee meeting of the Wireless Section of the Institute of Electrical Engineers in London, Dr. Smith-Rose, the radio scientist now in America, forecast a trans-Atlantic freight service by pilotless aircraft, which, he said, would be remotely controlled from land bases and flown over specially selected routes. Radio-operated devices would prevent collisions.

The war, he explained, had brought about revolutionary advances in radio as an aid to aerial and marine navigation, and the results would clearly be applicable to direction-finding with the aid of transmissions from beacons.

Pan-American Preparation

PAN AMERICAN AIRWAYS cannot be accused of letting the grass grow under its landing-gear, for it has recently published a post-war world time-table for July, 1948.

Possibly the most interesting item is: "Leave New York 3 p.m., arrive London 8 a.m. next day. Return fare, £46." Allowing for the five hours' difference in time, this means a 12-hour trip at a return fare which is about two-thirds the *cost* of carrying a passenger *one way* in a present-day four-engined aircraft as estimated by a British expert not long ago.

Informal Presentation

A DELIGHTFUL story from Kandy, Ceylon, illustrates how the grim realism of war cuts away unnecessary formalities even when it comes to the presentation of awards.

Col. Philip Cochran, the U.S.A.A.F. commander of the Air Commando Force, who was recently awarded the D.S.O., received an invitation to lunch with Air Marshal Sir John Baldwin at his bungalow.

After lunch they strolled out into the garden and Sir John, taking the decoration from his pocket, pinned it on his junior colleague with the casual remark, "By the way, Phil, this is yours—and you damn well deserve it!"

TAXI: Frank N. Piasecki, president of the P-V Engineering Forum Inc., demonstrating his new helicopter in public for the first time at Philadelphia. With a speed of 95 m.p.h. and capable of landing in a 50ft. square, its post-war potentialities are obvious. Note the hooter just below the side window

Undercarriage Weight

MR. ARTHUR GOUGE has pointed out to us that in the summary published in our issue of February 10th of his lecture to the London Association of Engineers, the sentence which dealt with his comparison of flying boat and landplane undercarriages was open to misunderstanding.

His actual words were: "The weight of wing floats and hull of a flying boat of, say, 100 tons can be predicted with reasonable accuracy and would be approximately 12-13 per cent. of the all-up weight. The main chassis, tail chassis plus body of a similar landplane will probably be 13-15 per cent. of the all-up weight."

The glider pilot takes up cycling.

Dry Dock

CASES of big flying boats being successfully put down on dry land must be few and far between, though the feat has several times been accomplished on nice oozy mud, and on wet grass, with a low coefficient of friction.

But we recently mentioned on this page the case of an Australian Sunderland pilot who safely landed his boat on an airfield because its hull was badly holed and now comes news, via *The Martin Star*, of a 24-ton Martin Mariner being accidentally landed at night on a stretch of sand, which would be a very different proposition from, say, wet grass. Photographs support the story.

The only damage sustained by the Mariner, says the report, was two coats of paint scraped off the bottom of the hull and a damaged wing float. "Not even a rivet popped," announced the makers with just pride.

For Consultation

A DESIGN and technical service is offered by Technicair, Ltd., a newly formed firm of aeronautical consulting engineers which, in addition to experimental work, is prepared to assist companies or individuals in surveying aircraft and submitting reports on repair problems, etc.

The directors are Mr. H. Best-Devereux, who has had considerable design and development experience, and Mr. D. R. Williams, formerly of the A.T.A. Post-war private aircraft will be a speciality.

D

British Helicopters

First Account of Little-known Pioneer Work : Valuable Data Gathered With Two "Flying Test Beds"

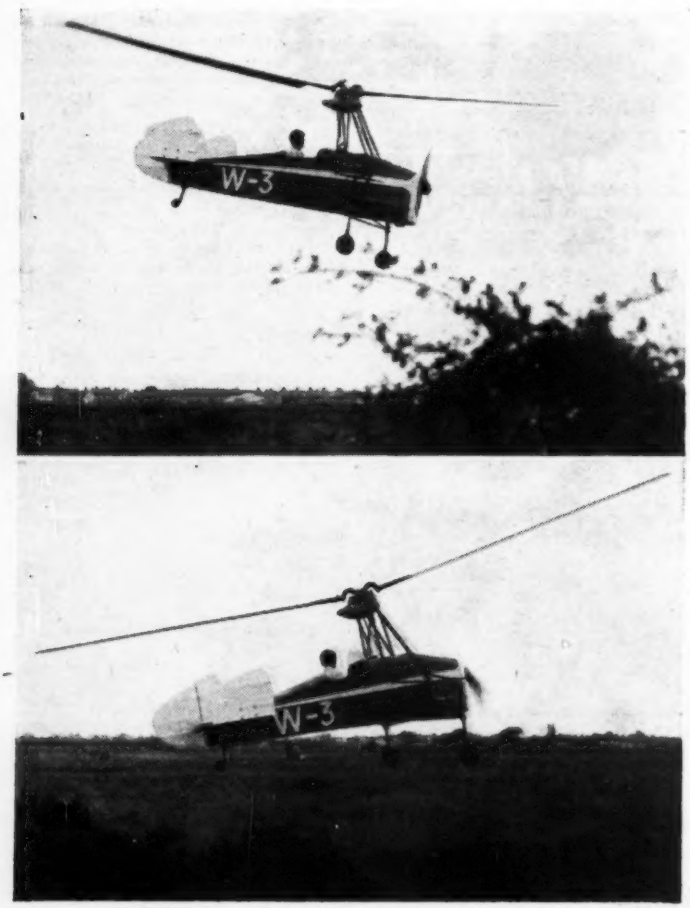
By THE EDITOR

"THERE are some 70 or 80 different designs being worked on, 10 or 12 of which will presently be successful, three or four of which—Piasecki, Le Page, Young *et al.*—are currently flying well." This statement by Mr. Grover Loening, chairman of the Helicopter Committee of the American National Advisory Committee for Aeronautics, taken from a pamphlet recently issued in this country by R. K. Dundas, Ltd., might give the impression that all helicopter development is being done in the United States. The secrecy which has hitherto surrounded work done in Great Britain has done nothing to correct that idea, and in fairness to our own pioneers we have felt that an account of their early work should now be given.

Mr. Loening's extremely interesting, and eminently sane and timely article, makes it quite clear that there is a very long way to go yet before the helicopter can be regarded as everyman's aircraft. Of the Sikorsky R-4, for example, after admitting that it has been brought to a high degree of perfection, he says that, although control is complete—in fact, amazing—there is one hitch: the controls are delicate and require careful co-ordination and are not easy to master without sufficient training. (We believe we are right in saying that a pupil requires more than 20 hours of training before he can handle the Sikorsky.) "The net result of all this," Mr. Loening says, "is that the helicopter at present and for many years to come is hard to fly—requires co-ordination of five controls—and for that reason is far less suitable for the use of the ordinary layman than is the airplane. Any notion, therefore, that everybody is going to fly helicopters right after the war is nonsense."

These extracts must not be taken to indicate, as well they might if left unqualified, that Grover Loening does not believe in the future of the helicopter. On the contrary, he is optimistic, and foresees many uses for this type of aircraft. But as chairman of the N.A.C.A. Helicopter Committee (the N.A.C.A. is now proceeding with an ambitious programme of research), he knows the difficulties, and takes a realistic view of the situation.

We have stressed the fact that the problems involved are difficult because it is against that background that one should judge such work of the British pioneers, G. and J. Weir, Ltd., as may be referred to in print. It was in March, 1938, that G. and J. Weir, Ltd., completed their first helicopter. It made its first flight on June 7th, 1938, at Dalrymple, Ayrshire, and was flown frequently up till October, 1939, and demonstrated before many M.A.P. officials. In all, the machine, which was a single-seater, made more than 100 take-offs and landings, but in October, 1939, it was dismantled to make room for a two-seater, which made its first flight in that month. The two-seater was in continual use until July, 1940, when the Weir helicopter department was closed down so as to release personnel for urgent war work. For a very long time it was found impossible to obtain official permission to resume work on helicopters, but some months ago we were able to announce that premises had been obtained in the London area, and that developments might be expected. Of the recent work nothing may be said except that it appears to indicate that the day of "helicopters for all" may possibly not be so very many years ahead after all.



Half-way towards the helicopter. Two pictures of the Weir jump-start Autogiro clearing obstacles on take-off and landing.

Fundamental Differences

However, to resume the Weir helicopter history, this really began with the Weir W.3 jump-start Autogiro, the first illustrated description of which was published in *Flight* of July 23rd, 1936. That machine, it may be recalled, was an Autogiro in that in flight the rotor was not driven by the engine but was simply a "windmill." In the actual start, however, the rotor was speeded-up by the engine to well above its flight revs, the blades being set at an angle of no lift. When sufficient rotor speed had been reached, the pilot increased the pitch angle of the blades, the engine being declutched at the same time. The energy stored in the flywheel formed by the rotor was then used to jump the machine a few feet into the air, the forward speed being picked up quickly and the rotor windmilling as in any Autogiro.

From the jump-start Autogiro to the helicopter was a logical step, but by no means as easy as might be supposed. In the Autogiro the

The Weir W.5 helicopter made its first free flight on June 7th, 1938. It had a 50 h.p. Weir engine.

On the W.5 the two-bladed rotors were carried on wooden box-section outriggers.

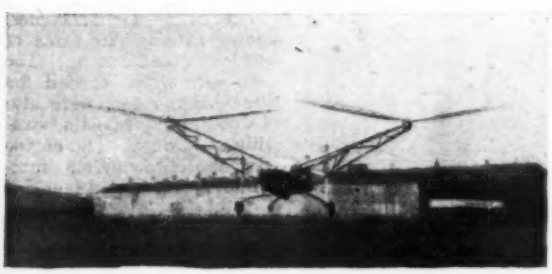
forces in the rotor hub were fairly small and mainly confined to heavy loads caused by centrifugal force on the blades. When, however, the blades have to be driven by the engine, all manner of difficulties arise. Torque has to be transmitted, and the rotor blades need a fair amount of "taming," with their habit of flapping up and down as the airspeed over them is increased or decreased by the forward speed of the aircraft. In addition they do not always remain the same distance apart, sometimes trying to overtake one another and sometimes lagging behind. Furthermore, things have to be so arranged that, should the engine stop, the blades will auto-rotate as in an Autogiro. Then there is the possibility that the engine might stutter for a few seconds and suddenly pick up again. That would probably spell disaster to the transmission or to the blades themselves, and so that contingency has to be guarded against.

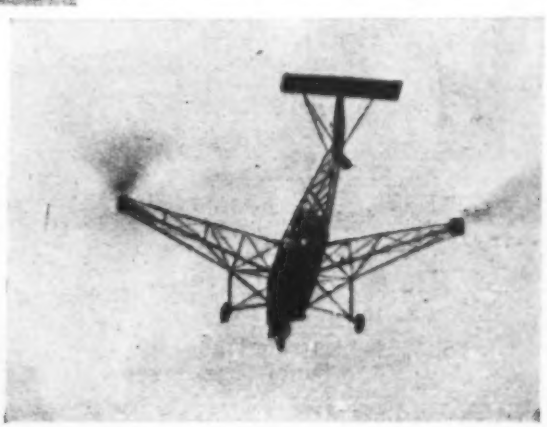
Torque Reaction

Even this does not by any means finish the list of problems. So long as the blades were windmilling, the flapping of the blades took care of uneven lift on the two sides of the aircraft. But when the rotor hub is driven by the engine, there is torque reaction to be taken care of. This has been a real problem with single-rotor helicopters, and many alternative solutions have been tried or suggested. In the Sikorsky, for instance, torque-reaction is balanced by a small vertical airscrew at the tail, the thrust of which is varied by altering the pitch angle of the blades. To arrange not only for transmission from the engine to the tail airscrew, but also for pitch change is no easy matter, and this solution, although Sikorsky has made it work, strikes one as being a clumsy one at best and not likely to be the final solution.

Mr. C. G. Pullin, who had joined Weirs in 1933 to develop small Autogiros and engines for them, and who had made the W.3 jump-start machine referred to above, fully realised that the first step in any helicopter development was to solve the problems connected with the rotor system. At that time (1936-37) certain features were thought to be suitable for the operational requirements, and Mr. Pullin had to work to that system. It ultimately proved inadequate, but the experience gained has been invaluable and has shown Mr. Pullin the way to vastly improved systems. In the meantime, he had to make the best of the then existing scheme, and his translation into prac-

Cold work. The W.6 taking off. The passenger on this occasion was Sir Arthur Tedder.
(Below) The W.6 in flight. Note the coning angle of the rotor blades.
The "worm's-eye" view on the right gives a good idea of the general layout of the W.6.





BRITISH HELICOPTERS

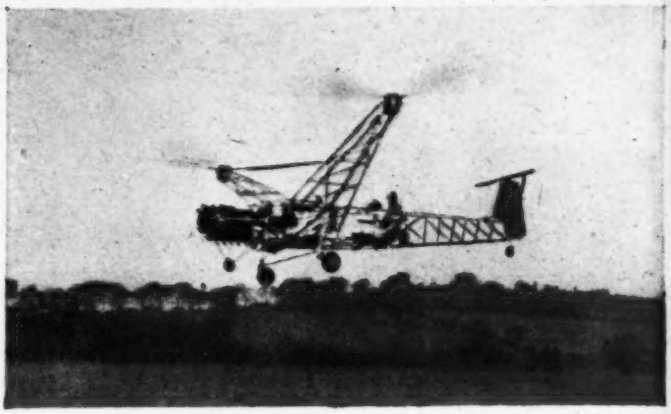
tical engineering of the theories then obtaining was later described by Lord Weir as "a monument to mechanical engineering."

In this connection it is interesting to find that his studies and researches have led Igor Sikorsky to the same basic rotor system so far as cyclic pitch change and rotor drive are concerned.

Reference has been made earlier to the problem of counteracting torque reaction in a single-rotor helicopter. When G. and J. Weir decided to initiate research into rotor systems, it was decided that by employing two rotors, side by side, running in opposite directions, at least that problem would be side-stepped. The two-rotor arrangement was never regarded by them as the ultimate solution, but it did give an opportunity to study other problems without having to tackle that one at the same time. Moreover, the Focke-Wulf concern of Bremen (who earlier had obtained the German licence to build Cierva Autogiros) had built a side-by-side rotor helicopter which had performed well, so there was justification for believing that for a "flying test bed," which was all the first Weir helicopter was intended to be, this arrangement would short-circuit some of the problems.

Just to make absolutely sure that there was no "easier" way, a unit with two superimposed coaxial rotors was designed and some components tested. It was concluded, however, that this arrangement introduced so many aerodynamic and constructional difficulties that the side-by-side arrangement was finally selected.

One of the reasons for this was also that, in an experimental machine such as that contemplated, the possibility of mechanical failures could not be ruled out and it was thus necessary to guard against serious accidents by ensuring that the machine would be able to descend *en Autogiro* (with the blades autorotating) at a reasonable rate. This entailed rotors of fairly large disc area.



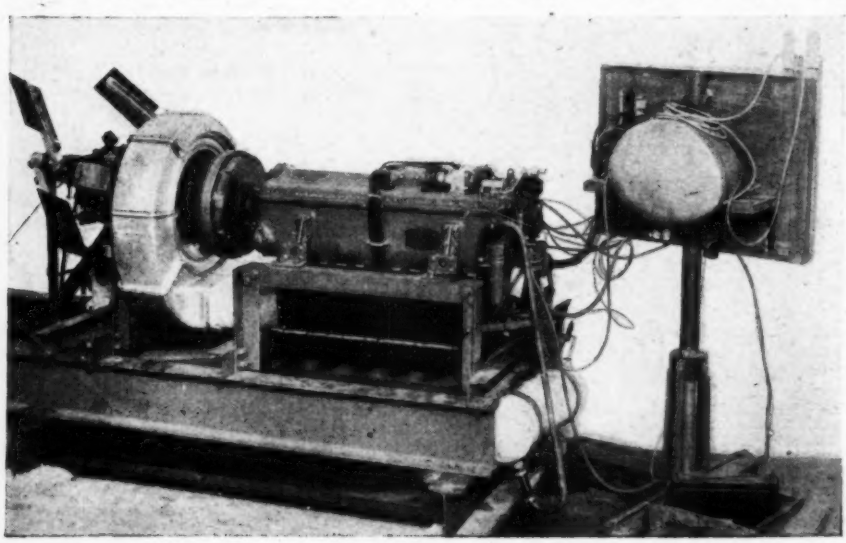
Mr. R. A. Pullin flying the W.6. This machine carried many passengers, on one occasion two of a combined weight of 300 lb.

Mr. R. A. Pullin in the cockpit of the W.6 during a flight, snapped by his passenger. The instrument panel does not look very terrifying.

The rotor hubs for the side-by-side arrangement were designed to operate on the direct-pitch-control principle instead of on the tilting-rotor-head principle used in the Autogiros. For control while hovering, two methods were tested. In one, control about the rolling and pitching axes was by tilting the lift vector by the application of harmonic pitch change; in the other, control about the rolling axis was obtained by continuous differential pitch change (adding pitch to one rotor and reducing the pitch of the other), and about the pitching axis by harmonic pitch change. Both were found to work satisfactorily, but less displacement of the aircraft occurred when the rolling control was by differential pitch change, and most of the flying was done with that arrangement.

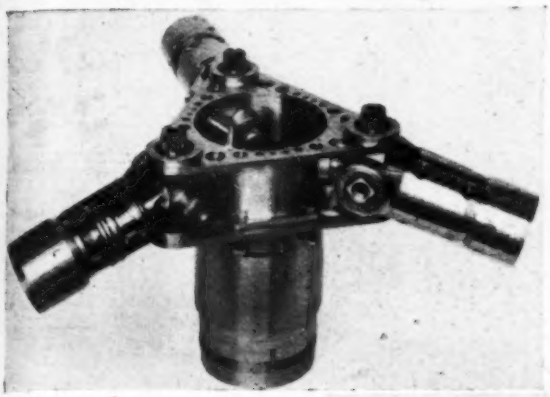
Normal flapping and drag hinge articulation were included, together with a free-wheel on the final rotating member of the hub. This permitted autorotation as soon as the desired condition arose.

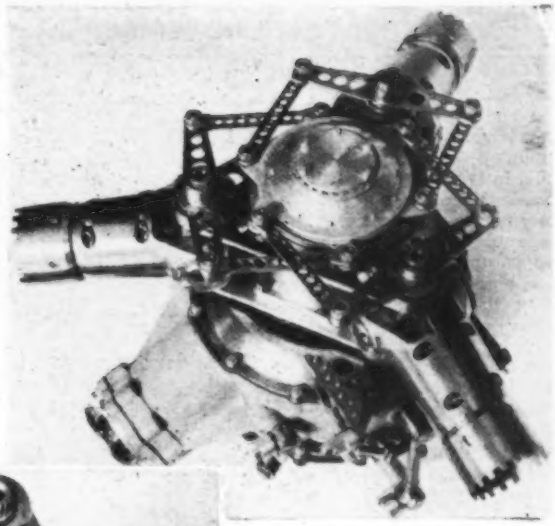
The first Weir helicopter, known as the W.5, was of wooden construction. The outriggers which carried the side-by-side rotors were also of wood and were plain boxes without fairings. The engine was the little Weir four-cylinder air-cooled engine



Test rig for the special cooling fan on the Gipsy Six.

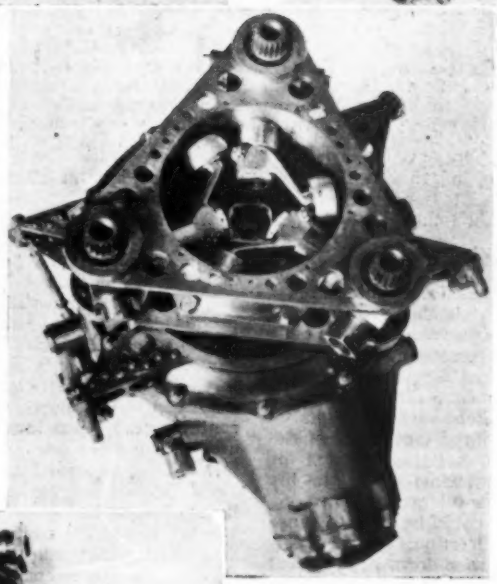
BRITISH HELICOPTERS





The rotor head partly assembled, showing flapping and drag hinges, and the control piston, which is operated by chains and sprockets, one for simultaneous and the other for harmonic pitch change. (Right) Looking down into the rotor hub. The bell cranks operate the pitch of the blades.

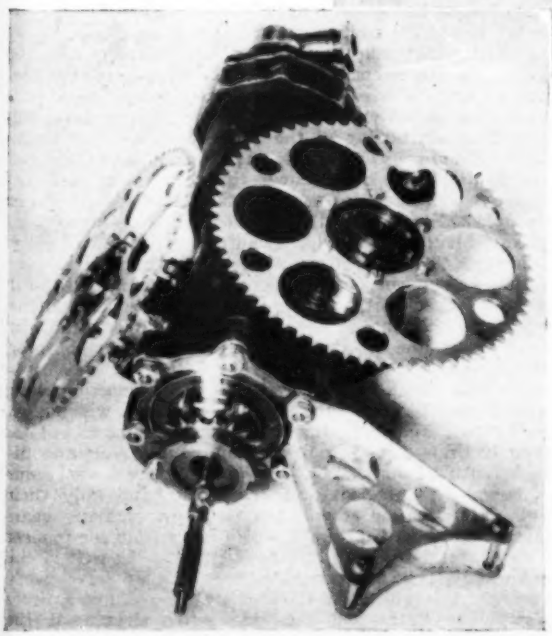
In this view of the complete rotor hub the most prominent feature is formed by the friction-damper connecting links. The damper is centrally placed.



designed by Mr. Pullin for the small jump-start Autogiros. It developed 50 h.p. at 2,500 r.p.m., and in the W.5 it was cooled by a special blower. Transmission was via a single-plate clutch to a primary gear-box and thence by universally-jointed shafts to the rotor hubs. The two-bladed rotors were geared down to run at 410 r.p.m., and the length of the wooden blades was 7ft. 6in. Complete with pilot, fuel and oil, the loaded weight was 840 lb., so that the power loading was in the neighbourhood of 17 lb./h.p.

As already mentioned, the W.5 made its first flight test on June 7th, 1938. The pilot was Mr. Pullin's son, R. A. Pullin, R.A.F.V.R., whose pilot's licence was the first to be endorsed for helicopters. Later he served in the R.A.F. on active service, was brought down several times, and he is now a prisoner of war in Germany.

The next helicopter, the W.6, was completed in October, 1939, and the little W.5 was dismantled. In the W.6 the same rotor arrangement was employed, but the machine had a Gipsy VI, series II, of 200 h.p. at 2,400 r.p.m. A special blower was designed for cooling it (see photograph). The W.6 was of metal construction so far as the airframe was concerned, but the rotor blades were of wood. Light-alloy tubes were used in the fuselage, except in the rear bays, which were of steel tube. The transmission was via a fluid coupling (clutch) to a primary gear-box and by universally-jointed shafts to the rotor hubs. The three-bladed rotors ran at 275 r.p.m., and the wooden blades had a length of 12ft. 6in. The loaded weight, with pilot, passenger, fuel and oil, was 2,400 lb.



The pitch-control box of the W.6. One sprocket controls harmonic pitch change, the other simultaneous pitch change.

Distinguished Passengers Carried

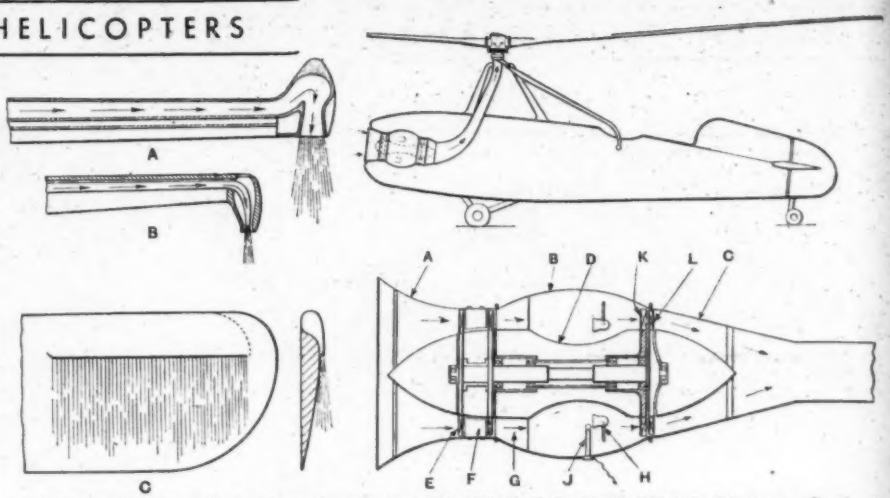
On October 10th, 1939, the W.6 made its first flight, Mr. Pullin again being the pilot. The machine was flown frequently until July 1940, when as already mentioned the department was closed down to release personnel for more urgent war work. Many passengers were carried, among them being Sir Arthur Tedder. On one occasion, as the log sheet shows, the machine carried two passengers, of a combined weight of 300 lb. One notable feature of the remarks written by passengers is the regular occurrence of the phrase "machine very smooth."

The rotor head of the W.6 is shown in various stages of completion in the photographs above. The main hub

BRITISH HELICOPTERS

body was an Elektron casting and carried the spiral bevel gears which were mounted on an axle running in large-diameter ball bearings and passing the torque through a ratchet-type freewheel to the upper portion of the axle and blade articulation.

In the pictures of the rotor hub may be seen the flapping and drag articulation of the three blades, and the link connections to the centrally placed friction damper. The blade-root fitting vernier adjustments were supported on radial bearings and heavy-duty thrust races to meet the centrifugal loads. The blades were constrained in torsion by a special form of constant-velocity joint situated on the common centre of the drag and flapping hinges. This special form of joint was necessary to allow of drag and flapping displacement without affecting the pitch change.



Jet-propelled rotor blades have been patented by Mr. C. G. Pullin for Weir helicopters. On the left are three types of jet nozzle. The upper right-hand drawing shows the turbine-compressor power unit in the machine, and details are clearer in the enlarged view, in which A is the air inlet ; B, the combustion chamber ; C, effluent duct ; D, central member ; E, compressor rotor ; F, guide vanes ; G, exit vanes ; H, fuel nozzles ; J, igniter plugs ; K, turbine entry vanes ; and L, turbine rotor.

Pitch Articulation

Inwardly projecting arms or cranks (see photographs), splined to extensions of the pitch articulation, carried spherical joints which, in turn, were positioned on the connecting-rods. Reciprocation of the connecting-rods caused the blades to turn about the torsional hinges. Movement of the three connecting-rods in the same direction caused the blades to take on or discard pitch, such as might be required for rolling control. Differential movement of the connecting-rods produced harmonic variation of pitch for control about the pitching axis, or inclination of the lift vectors for translational speed, forward or backward.

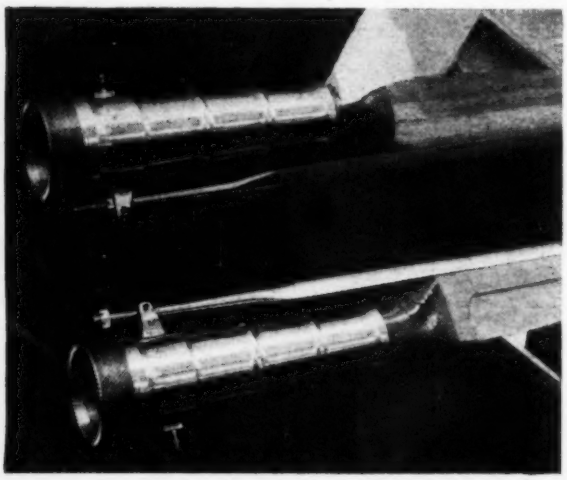
Application of the rolling control could be used to cause the machine to fly in either lateral direction. The connecting-rods carried, at their lower ends, a form of spherical joint similar to that employed at the top link connection and were coupled to a yoke which, in turn, was located on a swashplate member by ball bearings and free to rotate thereon and to rock about a bell-crank pin.

The control piston supported the bell-crank and a yoke which, under the influence of a lateral control sprocket and a threaded member coupled thereto, effected a rise and fall of the piston, thus changing the pitch angle of all blades simultaneously. Harmonic pitch change was produced by turning another sprocket (pitch axis or fore-and-aft control) which allowed the inner threaded member to displace in an axial sense the lower bell-crank pin, thus forcing the swashplate member to rock about the pin. This displaced the connecting-rods differentially from the horizontal datum, thus introducing harmonic pitch variation around the rotor disc. The magnitude of the pitch oscillation thus depended on the amount of applied control. Both lateral and fore-and-aft controls could, of course, be applied at the same time, and also differential tilt of the lift vector for control about the yawing axis.

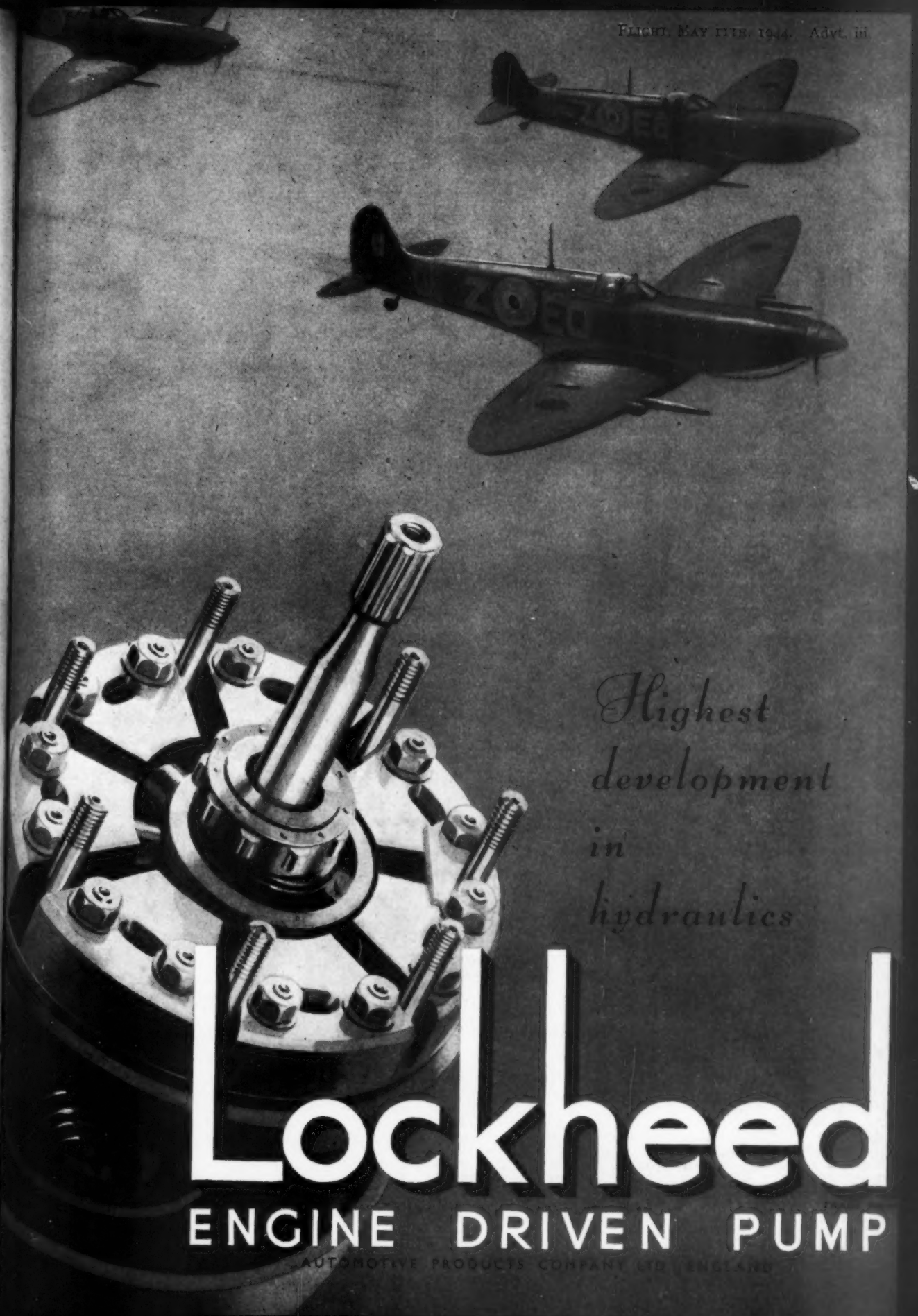
A short, universally jointed shaft and coupling took its drive from a universal joint and, being secured in the yoke member, located the swashplate member in correct phase relationship and, at the same time, permitted of torque-free functioning of the connecting-rods and links.

An hydraulically operated brake was incorporated for parking and for slowing-down the rotor after landing. Change-over from helicopter operation to autorotation was accomplished by closing the engine throttle. A pre-determined reduction of rotor speed caused the blades to change pitch through the medium of a hydraulic relay similar to the well-known constant-speed unit. An additional torque-balanced unit, working through the medium of the same relay, eliminated the possibility of overturning in the event of the failure of either transmission shaft or drive component.

It is very much to be hoped that this pioneering work on helicopters, which has now been resumed, will not go unrewarded, and that sufficient official support will be given to bring the work to fruition. Lord Weir and his brother, Air Commodore J. G. Weir, have spent vast sums of money on autogiros and helicopters, and only their Scots determination could have faced for so many years the number of set-backs with which the path of the pioneer is ever beset. If Great Britain is found to be well in the forefront of helicopter development, and we have every hope that this will be so, the credit will be almost entirely due to the faith—and the long purse strings—of the brothers Weir, and to the technical ability of Mr. C. G. Pullin.



The tapered and shouldered blade hubs. Note the metal leading edge and its attachment.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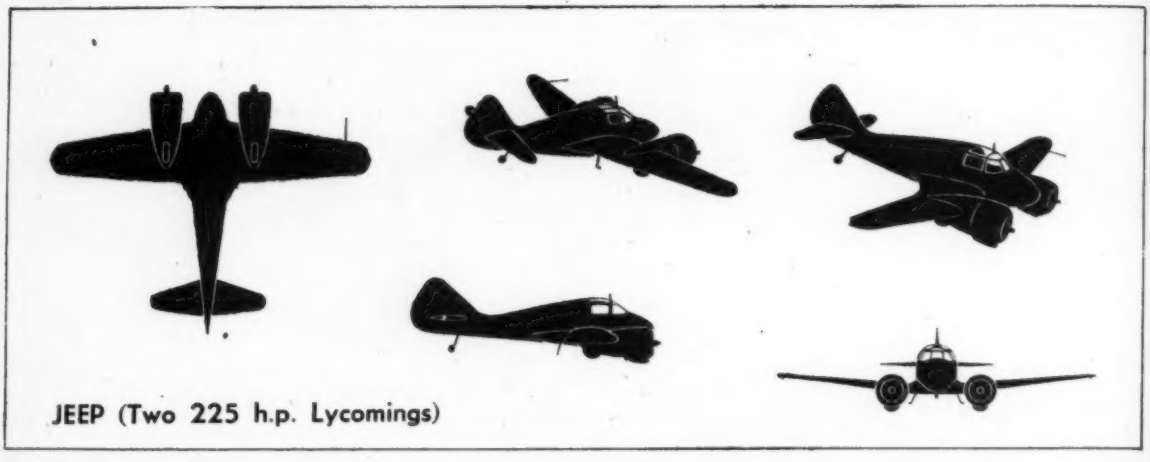


JEEP (Two 225 h.p. Lycomings)

DESIGNED from the outset as an advanced trainer for the U.S.A.A.F., the Curtiss AT-9 Jeep is of all-metal construction and reproduces to a marked degree the characteristics of bigger twin-engined combat types. Powered by a pair of 225 h.p. Lycoming radial engines, its top speed is 200 m.p.h. Its landing speed has purposely been kept high at 110 m.p.h. It is normally a side-by-side two-seater, but two extra seats can be added when required. A very comprehensive instrument panel and an automatic pilot are provided.

Small in overall dimensions for a twin-engined type, the Jeep can be recognised by its "teardrop" fuselage, whose small nose does not project quite as far as its c.s. airscrews. The low wings have dihedral from the roots and taper to semi-circular tips, as does the tailplane. The large single fin and rudder is of low aspect-ratio. Dimensions: Span, 40ft. 4in.; length, 31ft. 8in.; height, 9ft. 10in.; wing area, 152 sq. ft.

Curtiss AT-9 Jeep advanced trainer.

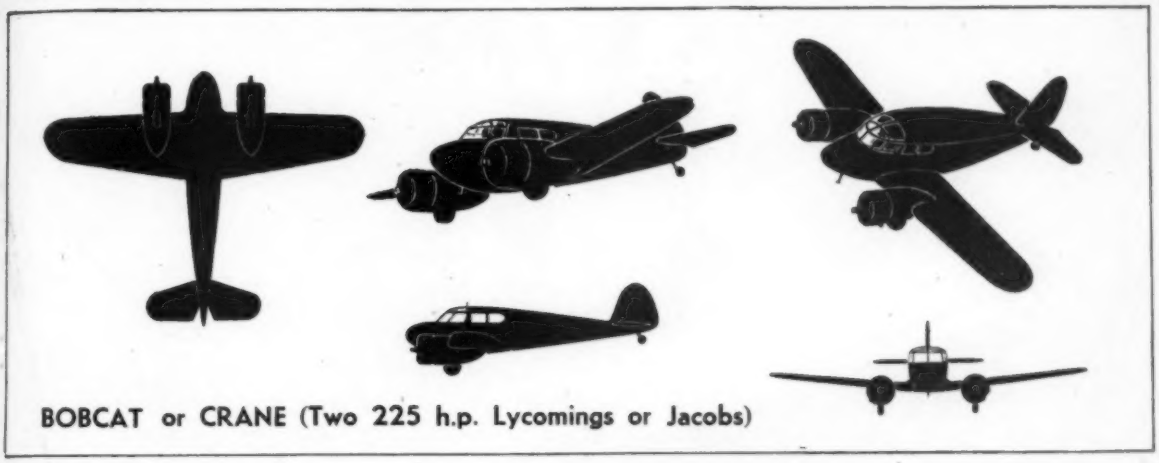
WICHITA (Two 275 h.p. Lycomings)

Beech AT-10 Wichita advanced trainer.

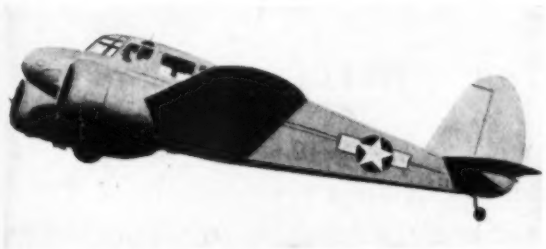
SIMILAR in purpose and general lay-out to the Curtiss Jeep, the Beech AT-10 Wichita differs from it in being of wooden construction instead of all-metal. By means of much sub-contracting, great numbers have been produced for the U.S.A.A.F., and it was the first wooden advanced trainer to be accepted by them. Two 275 h.p. Lycoming radial engines provide the power, and the top speed is about 190 m.p.h.

Very similar to the Bobcat (or Crane) in side and front views, it can readily be distinguished in plan view by the sharply tapering wings and more angular tailplane. The narrower fuselage, straight top line and pronounced rake to the front screen of the two-seater cabin also help one to tell it from the Cessna product. The large single fin and rudder is unusual on Beechcraft, previous types all having twin tails. Approximate dimensions: Span. 44ft.; length, 32ft. 5in.; height, 11ft. 3in.; wing area, 237 sq. ft.

Flying Attitudes



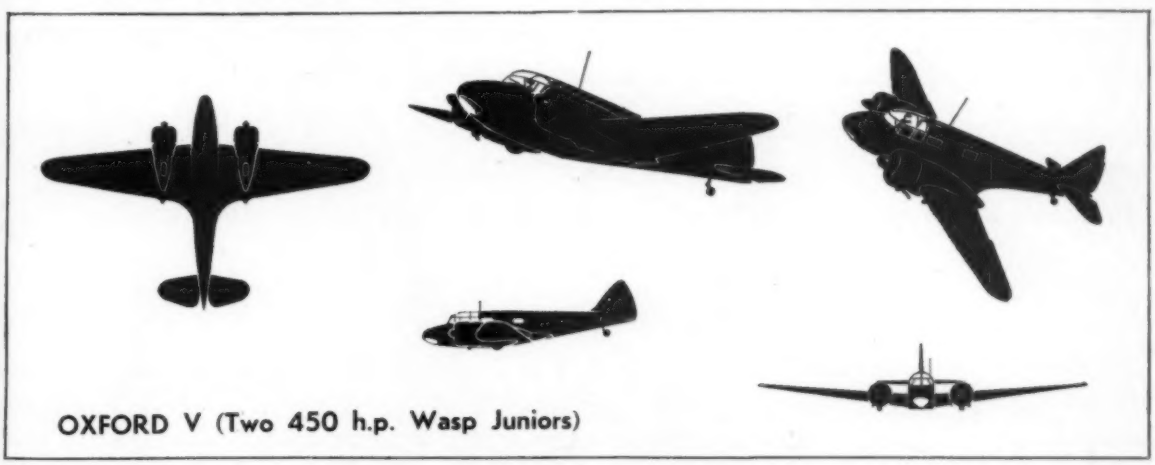
BOBCAT or CRANE (Two 225 h.p. Lycomings or Jacobs)



Cessna AT-17 Bobcat advanced trainer.

MILITARY version of the Cessna T-50 five-seater light commercial type, the Bobcat is powered by either 225 h.p. Lycoming or Jacobs radial engines. In the former case it is the AT-8, and in the latter the AT-17; apart from engines, the two versions are identical, but the AT-17 is the Cessna Crane of the R.C.A.F. When used as a personnel transport by the U.S.A.A.F. it is the C-78. Besides providing advanced training, the Crane can also be equipped as an ambulance or photographic aircraft. A four-seater version for instructing wireless operators is also produced. Top speed is about 195 m.p.h., but it lands at only 55 m.p.h.

Recognition points include low wings with dihedral from the roots and tapering almost entirely on the trailing edge; rounded tips; the tailplane tapers on leading edge only and has semi-circular tips; large single fin and rudder. Dimensions: Span, 42ft.; length, 33ft.; height, 9ft. 5in.; wing area, 295 sq. ft.

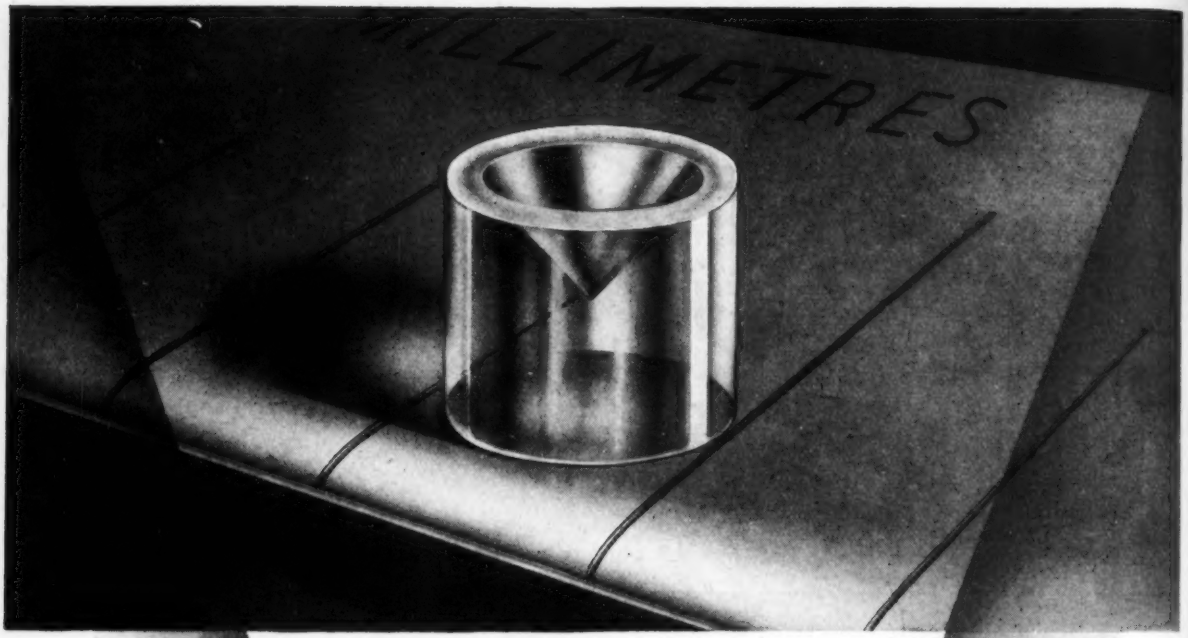


OXFORD V (Two 450 h.p. Wasp Juniors)

STANDARD advanced trainer of the R.A.F., the Airspeed Oxford is also in service in Canada, Rhodesia, Australia and New Zealand, and is used on ambulance duties in the Middle East. The Oxford V is powered by two 450 h.p. Pratt and Whitney Wasp Junior air-cooled radial engines and has a top speed of about 200 m.p.h. Earlier versions had Cheetah engines and were somewhat slower. The Mark I had a dorsal gun-turret, but this was omitted from the Mark II onwards, its duties at A.F.U. being conversion to twins and night flying training.

Somewhat resembling the Anson it replaced, the Oxford has higher aspect-ratio wings which taper to small semi-circular tips, a tapered tailplane with a "bite" in the trailing edge and round tips, and an almost pointed apex to its single fin and rudder. Dimensions: Span, 53ft. 4in.; length, 34ft. 6in.; height, 11ft. 1in.; wing area, 348 sq. ft.

Airspeed Oxford advanced trainer



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Propaganda

THE National Air Council of the Quisling Government in Norway has started publication of a new quarterly periodical, *Norsk Flyging*, the aim of which is "to keep all airminded people up to date with regard to development of technique on aviation."

Restrained

"THE Germans deny that the Allies have succeeded in destroying the German fighter force," says the Berlin correspondent of the *Dagens Nyheter*, "but are silent about whether the Allied air attacks have reduced fighter production."

Decorated

DR. CLAUDIUS DORNIER, head of the Dornier works of Friedrichshafen, has been awarded by Hitler the title of "Pioneer of Labour."

Others to get the award included Dr. Julius Dorpmueller, Minister of Transport, who was said to have been appointed Reich transport dictator last week, and Albert Voegler, chairman of the United Steels Works in Dortmund.

Conducted Tour

"A SIGHT-SEEING tour of Copenhagen for American airmen who made a forced landing somewhere in Denmark was organised by Danish patriots," says the Underground paper *De Frie Danske*, quoted by the Danish Press Service and Reuter.

"The patriots gave the airmen food and clothes, and the itinerary included the Royal Castle, the Amalienborg Palace and the Dagmarhuset—Gestapo Headquarters.

"The day after their Copenhagen tour the Americans crossed over to Sweden, and the only souvenir the Germans have of them is the article and pictures published by *De Frie Danske*, one of which shows them sunning themselves on a bench in the Royal Library Gardens."

Never Too Young

FIFTEEN-YEAR-OLD boys are urged by the Finnish Press to join the A.A. units. According to Mannerheim's wish the boys will be exempt from labour service obligations and an unlimited number of them will be accepted by the A.A. formations.

Luftwaffe Special

BERLIN military circles assert that *Luftwaffe* aircraft which carried out attacks on Allied shipping in the Mediterranean have been "specially built for this purpose."

Hitherto the *Luftwaffe* had only two special torpedo-aircraft, the He 111 and the He 115, and it is possible that some of the new larger types, such as a version of the He 177, have been adopted for this purpose.

Nips to Go Nap

AN all-out effort of the war industry to produce more aircraft is now being organised in Japan. To catch up with Allied output the aircraft industry is working day and night, and Prime Minister Tojo expects that by the end of this year the Japanese industry will double their output or produce five times as many aircraft as in 1942.

Quality may well be the first casualty of this battle for production, and it seems that even her allies realise Japan's difficulty of keeping pace with Allied technical superiority: "The Japanese Air Force," said a recent German report, "is expected to be soon in a position to counter the Anglo-American air war effectively—at least as far as its *numerical* strength is concerned."

Taken Over

THE newspaper *La Turquie* reports that the Bulgarian Air Force has come under virtual control of the *Luftwaffe* following a compromise between the Bulgarians and Germans. Under the terms of agreement the *Luftwaffe* has taken possession again of any aircraft delivered to Bulgaria since 1939, with a proviso that the aircraft, while passing under German control, will continue to be based on Bulgarian airdromes. All Bulgarian pilots from now on must undergo a minimum period of three months' active service in the *Luftwaffe* after a short training course in Germany. Upon the completion of their active service they will be eligible "to volunteer" for regular service in the German Air Force, receiving special pay and allowances.

The newspaper adds that Bulgarian fighter pilots already serving with the *Luftwaffe* under these conditions recently took part in the defence of Bucharest.

Preparing

ONLY time will show the real purpose of the new chain of airfields now being established by the *Luftwaffe* in Norway. But whether for defence or offence, reports indicate a feverish activity in the expansion of existing landing facilities and the construction of new ones.

Over 300 acres of forest have been cleared to make room for the big airfield which the Germans are building at Halsemoen, Flisa, about twenty miles from the Swedish border and about fifty miles from the big air base at Gardemoen which has recently been substantially enlarged.

The work on the Haslemoen airfield started in January and large areas have been evacuated, schools and churches requisitioned, and farms devastated. The whole district has been practically destroyed. One thousand Russian prisoners and 800 Norwegian slave labourers are engaged on the work.

Only twelve miles from this airfield another temporary one is being rapidly built, and the construction of a third situated close to the Swedish border, was started at the end of last month.

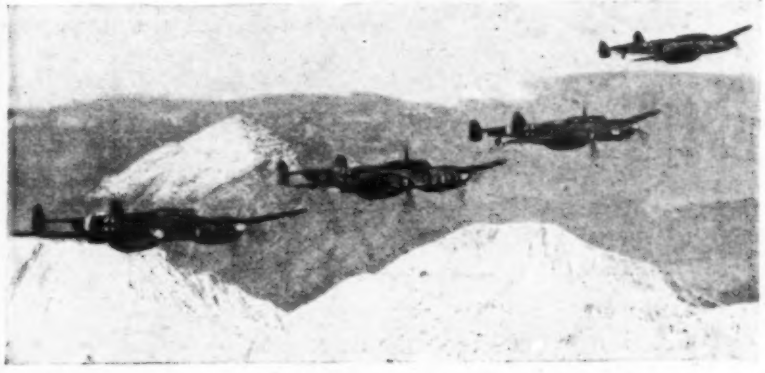
Both the Fornebu airfield, near Oslo, and the Bardufors, in the county of Troms, are being expanded.

The method used for the construction of these temporary airfields on frozen ground or lakes is first to remove the snow from the ice, then cover it with a layer of sawdust which acts as an insulator, and then a layer of gravel.

Ice treated in this way—it is said—can last until midsummer, provided the weather in the spring does not become unusually warm.

In Denmark, too, the *Luftwaffe* is preparing; the Kastrup airfield is being transformed from a training to an operational base; many bombers are reported to have arrived and stocks of bombs are placed around the periphery.

On the Avedore airfield the B.M.W. have installed repair workshops for their engines, while the Heinkel concern has taken over the engine shops of the naval dockyards.



LOOKING FOR TROUBLE: A German picture of a formation of Me 110s over the Alps, said to have been taken whilst on their way to intercept American bombers approaching from Italy.

Research

Its Planning and Application : A Record of Past Achievement and a Pointer to Future Development

By W. S. FARREN

THE Seventh Wright Brothers' Lecture was delivered to the Institute of the Aeronautical Sciences in Washington, D.C., by Mr. W. S. Farren, Director of the Royal Aircraft Establishment, Farnborough, Hants. It may be recalled that the 1943 Wilbur Wright Lecture was read before the Royal Aeronautical Society in this country by Dr. Edward P. Warner, vice-chairman of the American Civil Aeronautics Board, and that he had chosen for his subject "Post war Transport Aircraft." This interchange of lecturers between the British and American societies is extremely valuable, and both the Wright Brothers lecture and the Wilbur Wright Lecture dealt with subjects of the very greatest importance. This year the Wilbur Wright Lecture to the R.Ae.S. will be given by Sir Roy Fedden.

Older readers of *Flight* will need no introduction to Mr. Farren, but the younger generation should know that he

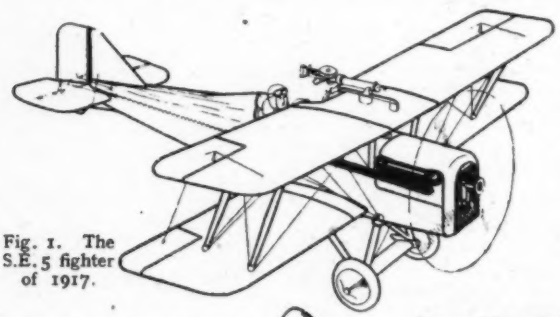


Fig. 1. The S.E. 5 fighter of 1917.

was once a Captain in the Royal Flying Corps and in charge of flying experiments and design at the Royal Aircraft Establishment, of which he is now chief. For a period after the last war he was on the technical staff of Armstrong-Whitworth Aircraft, afterwards becoming lecturer on aircraft structures at the Royal College of Science, South Kensington, and on aeronautics at Cambridge University.

Following are the main portions of Mr. Farren's lecture:

THE aim of research is to produce a theory firmly supported by experimental evidence. Though necessarily incomplete, it must be a close enough approximation to serve the man who has to make things work. I trust you will not infer from this statement that I am interested in research only for what I can get out of it. I have known the thrill of working solely for the fun of it. But I am interested, for the time being, in research with a clear and unmistakable objective—the discovery of how to make better aircraft. It is my experience that, for such research to be not only fruitful but timely, it is essential that the practical problems involved in its eventual application shall always be clear to those who are doing it. This need not in any way restrict their freedom. Indeed, they can gain immensely from contact with those upon whom the burden of applying their work is placed.

The theme I have taken is indeed that it is only by intimate and wholehearted collaboration between the research worker, the designer, the constructor and the user that research can be intelligently planned, pursued and applied.

The Independent Worker in Research

As a preliminary I propose to give you an example from my earlier experience which I feel puts the point as it appears to the independent research worker.

I have been personally concerned with research in flight for nearly thirty years. The two chief aerodynamic problems have been, and still are, the reduction of drag and the improvement of stability and control. Throughout, these problems have been attacked in the light of the practical questions thrown up by continuous contact, on the one hand, with those who design and build aircraft and, on the other, with those who use them. In my experience it has been this intimate relation between the three parties which has made this work so continuously exciting and, I believe, profitable. On looking back I cannot find any example that convinces me that we should have moved more quickly or more certainly had work on the fundamentals been divorced from that on problems of the moment.

It is true that at times, while we were developing our theory, we had the advantage of individual work going on in flight under conditions which I now believe to have been ideal. When I was one of the team who worked on these subjects at Cambridge we often felt that we could do more, or do it more quickly, if only we had more of something—men, aircraft, workshops—but chiefly more hours in the day. In truth, I think we did as much as was physically possible without enlarging our organisation, and, if we had done that, our work would have changed in character and would, I believe, have been less effective. That it had effect, and quickly, was due to our close relation with the establishments that had the necessary resources to exploit it for practical purposes with which they were intimately acquainted. They seized it and rapidly developed it. Its practical effect can now be seen not only in many aircraft but in the research equipment and programmes of work

You will remember Sir Melvill Jones' first Wright Brothers' lecture, in which he described some of the work I have just referred to on the boundary layer. From my own share in that work I can say that we were profoundly excited by the problems themselves and by the fascination of trying to

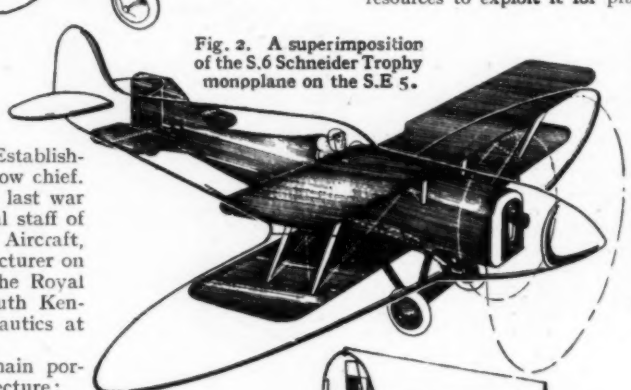


Fig. 2. A superimposition of the S.6 Schneider Trophy monoplane on the S.E 5.

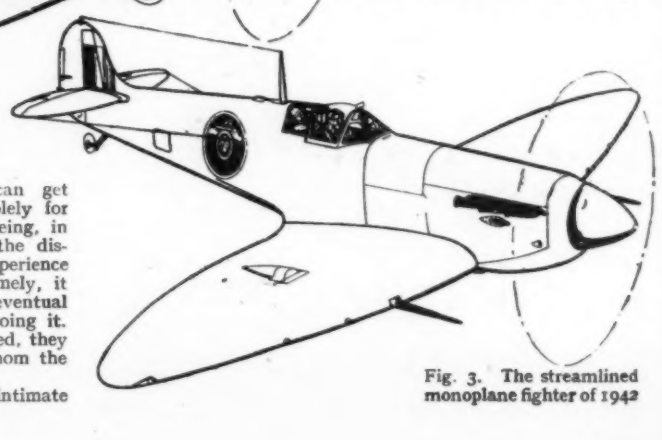


Fig. 3. The streamlined monoplane fighter of 1942

solve them by experiments in flight. But we were stimulated, and all our discussions were illuminated, by the realisation of the potential application of their results. This we obtained from our constant personal contacts with the experimental establishments and with aircraft designers.

Thus my experience leads me to the conclusion that, while there should be no explicit attempt to divorce work on basic problems from that on immediate ones of narrower range, the fullest encouragement and practical support should be given to independent workers. What form this should take I hesitate to define. My own preference is not for large endowments to institutions in the hope that they may attract good men. I would rather make generous finance available through some semi-independent advisory organisation when the need is made clear by the development of the work. This may be either in cash or in kind. We at Cambridge had very little money, but the country supplied us with aircraft and maintained and renewed them. My only concern is that the ponderous workings of the machinery of government, when finance is involved, may result in the essential help coming too late. One day we shall learn to trust our scientific advisers with a reasonable fraction of our money on a block-grant basis and ask no account except at long-ish intervals.

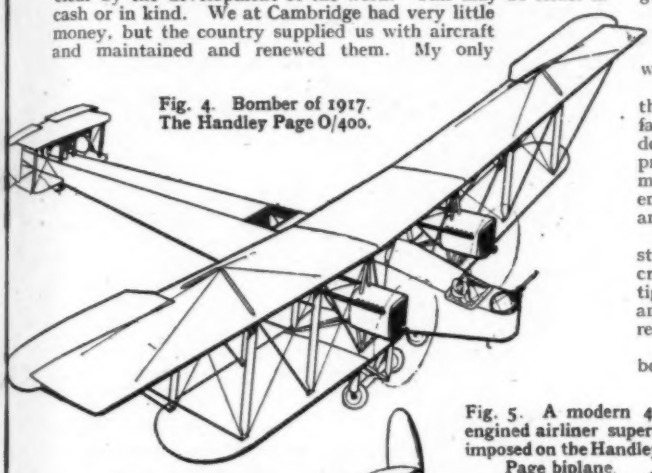


Fig. 4. Bomber of 1917. The Handley Page O/400.

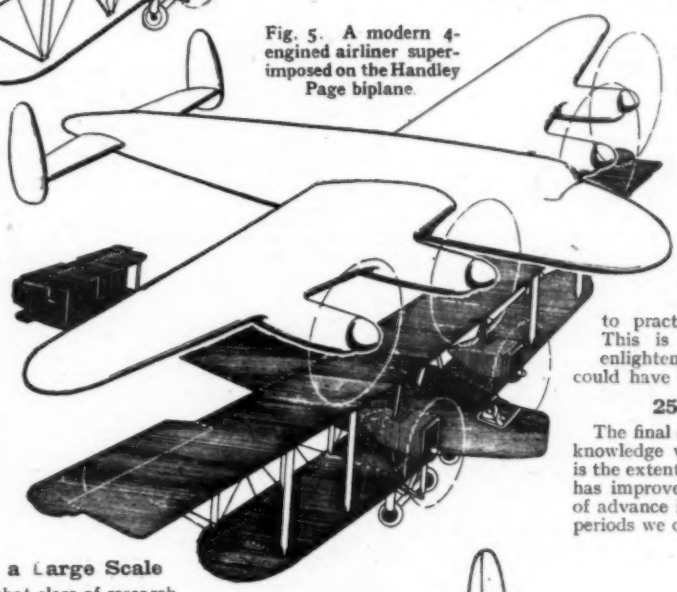


Fig. 5. A modern 4-engined airliner superimposed on the Handley Page biplane.

Research on a Large Scale

I come now to that class of research for aeronautics whose scale is such that success depends on planning of large experimental resources and on planning so that application to practice may meet the foreseen needs of design and its capacity to exploit new discoveries.

We must, in my view, plan research for aeronautics in three phases. First, we must relate all our main effort to advances in basic theory. Odd pieces of information without a clear, strong framework are worth little. Secondly, we must provide the experimental information by which theory may be built up and its limitations recognised and reduced. Thirdly, we must ensure that experimental application is made in such conditions that the practical value of the theory is confirmed.

There are three chief parties to this undertaking: first, those who are by trade workers in the field of theory and those who have the flair for the associated exploration by experiment; secondly, those who make use of the results in the design and construction of aircraft; and thirdly, those who use the aircraft and on whom we rely to exploit the product of the efforts of the first and second. The extent to which these should enter into planning of research can be illustrated by an example—the problem of reducing the cooling drag of power plants.

That it is possible to reduce the power wasted in cooling an aircraft power plant to 2 per cent. or less of the brake horse-power was established many years ago. Indeed, it was shown that, at flight speeds that were then within sight and have now been passed, the cooling could be made to help to propel the aircraft. But the cooling of a power plant is a matter that goes far beyond broad conceptions of this kind. It involves complex flows of air and liquids, demanding regulation to meet the varying conditions of flight and high standards of reliability in functioning and of ease of maintenance, which are of the greatest concern to the user.

It was not until other developments had reduced the rest of the drag so much that the power plant drag was a dominating factor that the designer became convinced that the problem demanded his serious attention. He has finally succeeded in producing cooling systems that are no less reliable and have a much lower drag. The user accepts the slight additional embarrassment to maintenance in return for the higher speed and greater range.

But the practical problems of achieving the full result are still only partially solved. Few power plants will stand up to critical examination on such points as low-loss ducting or air-tight cowlings. It is a difficult engineering problem to design and make such features at the same time light and easily removable and replaceable without damage.

Throughout the whole history of this development there has been intimate association between the three parties chiefly concerned. But in my view we can now see that a better planning of the enterprise as a whole would have saved much time and waste of work. In particular, an earlier realisation by the designer of the outstanding advance that was within his grasp would have brought him to a closer co-operation, on strictly practical lines, with his only source of specific information—the research establishments. They in turn were backward in that they did not provide themselves with the right material by which alone convincing information, directly applicable to practical problems could be obtained. This is a case in which I believe the enlightened user, if correctly advised, could have forced the pace.

25 Years' Achievement

The final criterion of our success in using the knowledge with which we have been supplied is the extent to which the product of our efforts has improved as time has passed. The curve of advance is not a smooth one. Over longish periods we often see little beyond a slow rise in

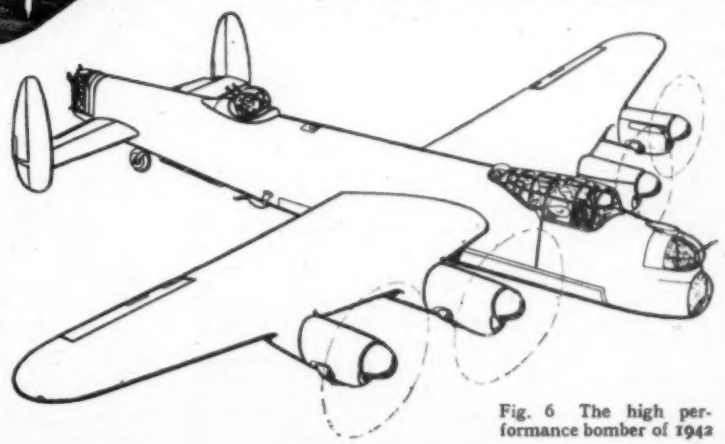


Fig. 6 The high performance bomber of 1942

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achievement, and we tend to believe that there is little more to be expected. Then there comes something in the nature of a transformation. It is often ascribed to a single cause and, generally, one can say that there is an outstanding stimulus. But if we compare the final product—in this case, the aircraft itself—before and after the event, allowing a long enough time for the situation to reach a fairly stable state, we can make a fair assessment of the relative weight of all the influences which have contributed to the change. I believe such an examination of the advance of aircraft between, say, 1917 and 1942, is useful in providing us not only with a means of examining how far we have been successful in using the results of research but also a guide to the part played by sheer engineering skill and initiative. Finally, it may serve as a base from which we may survey some of the potential advances that are now opening out to us and judge what resources we shall need in order to achieve them.

I shall take two typical aircraft that were in general and successful use in 1917 and compare them with two modern aircraft of similar duties. Naturally there are striking differences, and we shall find no difficulty in tracing them to their sources. But perhaps equally striking are the characteristics that have apparently undergone little change. I think, however, that we shall see that the effort to preserve them unchanged has made as nigh a demand on research and engineering skill as that required to produce the more obvious improvements.

Basis for Comparison

During the last war the Royal Aircraft Factory (which became the Royal Aircraft Establishment in April, 1918) produced many designs for aircraft which were constructed in large numbers. One of the most successful was the S.E.5, a single-seat fighter with a 180 h.p. Hispano Suiza engine. It had a creditable history as a fighter. I propose to compare it with a Spitfire. Then I shall take the Handley Page O/400 twin-engined heavy bomber and compare it with a Lancaster.

I shall not be giving away any information to our enemies. They are well acquainted, in more ways than one, with both Spitfires and Lancasters. Some of them may even remember the S.E.5 and the O/400. For my purpose it is quite sufficient to take examples of marks of the modern type whose performance has long been surpassed.

Let us first look at them in general outline: Fig. 1 shows the 1917 fighter. In Fig. 2 its specifically military features have disappeared and around it is the outline of the Schneider Trophy streamlined monoplane, the essential product of the period between the two world wars. Fig. 3 shows the 1942 fighter. In Figs. 4, 5 and 6 is shown the transition from the 1917 bomber, through the streamlined airliner, to the 1942 bomber. The most obvious differences are the change from biplane to monoplane and the general cleaning-up due to enclosing the crew, abolishing external wing bracing, and retracting the undercarriage. Comparing them type by type, the overall dimensions are not very different. The Spitfire has the same wing surface as the S.E.5, about half the drag, nearly twice the strength, three times the speed, four times the total weight, four times the military load, and seven times the power. The Lancaster has about half the drag of the Handley Page O/400 on the same span of wings and about three-quarters the wing surface. Its total weight is nearly five times as great, the wing loading, over six times; the power, seven times; and the military load, with a 25 per cent. greater range, over eight times. Let us enquire how some of these improvements have been made.

Drag Reduction

The change in drag coefficient C_{D_0} is of first interest. I have not found it possible to get accurate figures for the older aircraft, but they are approximately 0.039 for the fighter and 0.046 for the bomber. The corresponding modern figures are 0.022 for the Spitfire and 0.030 for the Lancaster. Thus, per square foot of wing surface, the total drag has been reduced to about 55 and 65 per cent. of the 1917 standard.

Comparing the two fighters in more detail, we find first that the wing surface is the same for both. Disregarding induced drag (or assuming it to be the same fraction of the whole in each), the top speed at the same height will be proportional to the cube root of the thrust power divided by the drag coefficient. Since the airscrew efficiency is near enough the same for both, we may use brake power. Taking ground level powers in both cases—180 h.p. for the Hispano and 1,250 for the Merlin—the ratio is about 7. Thus the contributions to increase of speed are:—

$$\text{by reduction of drag } \left(\frac{0.039}{0.022}\right)^{\frac{1}{3}} = 1.21$$

$$\text{by increase of power } (7)^{\frac{1}{3}} = 1.92.$$

The product of these figures is 2.33.

If we assume that by supercharging it is possible to keep the Merlin power constant up to, say, 25,000 ft., where the density is approximately halved, we shall get a further rise:

$$\text{by supercharging } (2)^{\frac{1}{3}} = 1.26.$$

The total ratio of increase is therefore nearly 3.

At this point I feel that the engine people are feeling very pleased—and we have good reason to acknowledge the success of their effort. But these figures as they stand do less than justice to the aerodynamic contribution. All the cooling required by the seven-times increased power has been provided and yet the aircraft has no more than half the drag per square foot of wetted surface.

How have these improvements been made? Let us look first at the drag account (Table 1).

TABLE 1

	S.E.5	Spitfire
	Drag at 100ft./sec.	Drag at 100ft./sec.
Wings	28	20
Wing bracing	15	—
Body and cooling	44	38.6
Tail surfaces	7	4.4
Undercarriage	16	—
Total	110 lb.	63 lb.
C_{D_0}	0.039	0.022

To the saving of 47 lb., the most obvious contributions are from the elimination of wing bracing and undercarriage—31 lb. in all. But the body and cooling drag is actually reduced by over 10 per cent. in spite of the seven-fold increase of power.

For the bomber, the reduction in C_{D_0} is rather less than for the fighter on account of the drag of defensive armament, but otherwise the influences operating have been much the same.

Towards the end of my paper I shall say something about what further improvements in drag are in sight and what problems we have to solve in order to achieve them.

Weight Analysis

Let us look next at the weight picture. The Spitfire weighs four times as much as the S.E.5; the Lancaster, nearly five times as much as the O/400. What has made it possible to carry so much additional weight per square foot of wing surface—for the fighter four times, for the bomber six times as much? In the aircraft itself, first, the development of flaps giving higher maximum lift coefficient and higher drag; secondly, power plants of much greater power per unit weight; and, thirdly, constant-speed airscrews to make the power fully available over a wide speed range. But larger and better airfields, permitting higher take-off and landing speeds and better flying technique have contributed even more. The effective maximum lift coefficient has risen by about 65 per cent. Even so, the touchdown and take-off speeds, with the higher wing loadings, are 50 to 80 per cent. higher.

A comparison of the weight analyses and load factors of the fighters is given in Table 2. As a matter of interest, I have given also the weight analysis for the FW.190.

TABLE 2

	S.E.5	Spitfire	FW.190
	per cent.	per cent.	per cent.
Structure	29.7	28.9	30.9
Power Plant	37.1	38.0	35.7
Fuel	15.4	16.6	14.3
Load	17.8	16.5	19.1
	100.0	100.0	100.0
Primary Load Factor	6	10	

How has this remarkable similarity of weight distribution been maintained? From the structural point of view, it is

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essentially by increasing wing loading four times that it has been possible to go from braced biplane to monoplane with nearly double the primary strength, from fabric covering to a metal skin, and from a fixed to a retractable undercarriage with no significant changes in percentage structure weight.

From the point of view of the power plant, we have to record a rise in the net output per pound of complete plant in the ratio of about 7 to 4. The complete plant of 1942 includes both constant-speed airscrew and supercharging arrangements by which the power is maintained up to heights at which the air density is half, or even less than half, of that at ground level.

For the same percentage fuel weight the range is some 40 per cent. better at a much higher cruising speed. Specific fuel consumption is much the same in spite of the great improvement in specific performance achieved in the face of the burden of supercharging. We must acknowledge here the tremendous contribution of high-octane fuel.

We are left in both cases with about one-sixth of the total weight for the man, his equipment, and armament. The weight of the man is the same as it was. In 1918 it exceeded that of his whole fighting equipment. To-day it is but a fraction of it. The weight of the bullets alone in the modern fighter exceeds that of the whole armament of the S.E.5.

For the bombers, weight analyses are strikingly different from those of the fighters

TABLE 3

	Handley Page 0/400	Lancaster
	per cent.	per cent.
Structure	40.4	31.4
Power plant ..	22.0	16.4
Fuel	19.3	19.8
Load	18.3	32.4
	100.0	100.0

In 1917 we thought it natural for the structure weight of a large bomber to be greater than that of a small fighter—40.4 per cent. compared with 29.7 per cent. In fact, there was a view, widely held and expressed somewhat forcibly by Dr. Lanchester, that aircraft of larger span than, say, 100ft. would be uneconomical because of the operation of the square-cube law characteristic of geometrically similar structures. Designers, aided by research, have managed to avoid the consequences of this law. They have been so successful that the structure weight percentage for the Lancaster is practically the same as that for the Spitfire. The load factor of the bomber is, of course, much lower than that of the fighter. But it is probably little different from that of the 1917 bomber. The progress that has been made is therefore remarkable.

In the achievements summarised above I think aerodynamic, structural, and power-plant improvements can fairly claim about equal shares, and to each, I suggest, the contributions of research and of engineering skill and ingenuity have been about equal. To pursue the analysis would lead me away from my main theme. But I think we may, with advantage, examine the history of effort in the structural and aerodynamic fields a little farther in order to show the nature of the difficulties that have been met and the methods by which they have been overcome.

Structural Developments

In 1917 the great majority of aircraft structures were made of wood and steel. Light alloys were little used. Wing surfaces were covered with fabric, and torsional stiffness requirements were met by the biplane wing structure. To-day with few exceptions we use light alloy for the primary structure, and torsional stiffness is derived in most cases from the light-alloy sheet wing covering. The very considerable improvement that has been made in aluminium-rich alloys contributes chiefly to the wing spars. There is as yet no marked sign of a development in their properties or application which will reduce the weight involved in meeting torsional stiffness requirements. This is, of course, because these involve stability rather than strength characteristics.

I do not suggest that the enormous effort that has been put into improving aircraft materials has not contributed to the maintenance of structure weight at a remarkably low figure in spite of increases of speed, strength requirements, and size. But it is significant that the Mosquito, which is made almost entirely of wood, has a structure weight as low as that of the equivalent metal aircraft.

Wing Loading and Wing Weight

One feature of the modern aircraft which has undoubtedly contributed to a more economical wing structure, in particular, is the great increase of wing loading and therefore of wing weight per unit area, which has made it possible to employ the material to much greater advantage—i.e., to have a smaller percentage of relatively lowly stressed material. This brings me to one of the outstanding contributions of research to aeronautics—namely, that derived from the investigation of the strength of actual structures in close association with theoretic analysis. It is by such work that it has been possible to increase greatly the useful load of practically all aircraft now in use. The most thorough mechanical testing of aircraft structures undoubtedly pays a high dividend. These tests have shown us not only that our methods of design have led us to general forms of structure well adapted to meet the demands on them, and fundamentally economical in character, but have enabled us to discover where our knowledge of the detailed distribution of stresses is inadequate and at the same time to improve that knowledge and to strengthen the structure against unforeseen local weaknesses.

The determination of the loads that the structure is called upon to bear is fundamentally a more difficult problem. We are greatly indebted to such methods as the V.G. recorder, but these give us only overall figures that, useful as they are, throw little light on the load distribution in flight. We have now available a method of great potency in the electrical resistance strain gauge. This is being used with great effect on a large scale in laboratory tests, and its application to measurements in flight is being rapidly developed. It will undoubtedly prove to be one of the greatest contributions of the research worker to improvement in the structures of aircraft.

Possibly the greatest achievement of the research worker in the field of aircraft structures is in discovering how to avoid the dangers of what we comprise in the term "flutter." In my view, there is in the whole of aircraft engineering no better example of the power of mathematical analysis, of ingenuity in experiment, and of skill in interpretation. The successful attainment of very high speeds, with a remarkably small number of serious failures, can only be ascribed to the most skilled use of all these resources, guided by systematic review of the results of their application. Direct experiment in flight—the only satisfactory check—is almost impracticable. Laboratory determination of reliable numerical values of the essential quantities involved is extremely difficult. Much more information on these is essential for progress, and here the designer can justifiably demand all that research can provide.

(To be concluded next week.)

SOVIET HONOURS P.R.U. PILOTS

SOVIET Government honours have been awarded to two R.A.F. men and an Australian airman who went to Russia last September on a special photographic reconnaissance mission.

They are Sqn. Ldr. F. A. Robinson, of Rushden, Northamptonshire, Order of Patriotic War (First Class), and Flt. Lts. B. R. Kenwright, of London, and J. H. Dixon, of Queensland, Medal for Distinguished Battle Service.

All three were members of the same squadron in Britain when to them was entrusted the task of photographing the German battleship *Tirpitz* in Alten Fiord, in Norway, in readiness for the British midget submarine attack on September 22nd, 1943, and of keeping tabs on the *Scharnhorst* where she lay just outside the fiord.

They took off on the clear morning of September 5th on the lonely five-hour flight to Russia, the R.A.F. ground crew who were to service the three Spitfires on their important mission having already gone ahead by sea.

Each of the three British pilots did eight to ten trips over the fiord. Anti-aircraft fire had to be dodged on each journey, and sometimes enemy aircraft tried to intercept the Spitfires, but never succeeded. The *Tirpitz* herself never opened fire. Most of the fire seemed to come from the shore, and possibly from flak boats, but none of the three was ever hit.

Then came the news that the submarines had attacked, but the Spitfires' work was not done yet, for damage assessment photographs had to be taken

The Spitfires operated from an airfield on which lay a thick covering of snow and ice, but by mid-October the job was done. Robinson and his two companions left their Spitfires for the Russians and returned, uneventfully, by sea.

Flight Testing

Doyen of British Test Pilots Explains His Work : Importance of Mutual Trust Between Designer and Pilot

"IT is axiomatic that from the underwriter's point of view the test pilot should be good, but the quality of his flying is of less importance than some other attributes. He must not damn, nor even dislike, a thing just because it is different from anything else within his experience."

That is about the neatest summing-up of the difference between an operational pilot and a test pilot we have ever come across. It is taken from a talk on test piloting which Mr. J. Lankester Parker gave to the London Association of Engineers last Saturday. He began his aeronautical career with Vickers in 1914, tested F.B.A. flying boats on Lake Windermere in 1915, joined Short Brothers and has been their chief test pilot ever since. Thus Mr. Lankester Parker has been a test pilot for a longer period of time than any other pilot in the country and has been doing the work without breaks (figuratively and almost literally!), although there was a time when he had precious few chances of testing new types. That was when a short-sighted Government cut down aircraft orders to such an extent that Short Brothers had to build bus bodies for a living.

Mr Lankester Parker stressed the importance of the designer and the test pilot thoroughly understanding and trusting each other. The flight-tester of a prototype aircraft is complementary to the designer. In his talk he did not confine himself to the testing of flying boats, although he has, of course, had vast experience of that type of aircraft. As he pointed out, one of the difficulties of testing aircraft is that the machine operates in two media, and that its behaviour on the surface bears practically no relation to its behaviour in flight. It is, of course, in the former that are found the main differences between landplanes and seaplanes.

Sequence of Tests

In describing the sequence of tests of a new type, Mr. Lankester Parker explained that the first is likely to be a handling and taxying test at low speed on the ground or water. During this the pilot has time to accustom himself to the layout, view and general "feel" of the machine. He will get used to the action of the brakes, or in a flying boat he will find out the best way of starting the engines, get clear of the buoy and so forth. Next will come a period of taxying at greater speed, during which flying speed will be almost reached, and the effectiveness of the controls begins to be assessable.

Then, if all has gone well, comes the most interesting and important test, the first flight. In a production aircraft a "cockpit drill" will have been established. In a prototype it is the test pilot's business to evolve this drill. Mr. Lankester Parker expressed his personal preference for taking off for the first time at less than full throttle, thereby prolonging the take-off run and giving himself a little more time to think, and to try out the controls gently. "There is, of course, another method," he said, "that of opening up the engines fully and just taking the risk; a grand method if everything is right!"

During the first flight, which may be of short or long duration according to how well the machine behaves, a number of tests may have been carried out, but, long or short, there is one thing which *must* be done: the first landing. He preferred to make one or two trial approaches at speeds somewhat higher than the minimum known to be safe, and to touch-down with some engine power.

Mr. Lankester Parker then outlined the first tests to determine that the aircraft is sufficiently controllable, after which the quantitative work would start, viz., proving that the three controls are adequate under all conditions without needing undue physical exertion.

Testing of Controls

On the subject of controls he pointed out that there is no exact rule. The effectiveness of the controls is tested at low speeds, control heaviness at high speeds. The elevator control he regarded as the most important of all. Fortunately it is relatively easy to test. Here he showed some lantern slides of the control forces on a Short Empire boat.

After referring to the need for sufficient rudder control to hold the aircraft straight with one engine off, Mr. Lankester Parker explained the other functions of the rudder, to be capable of trimming the aircraft directionally against disturbing forces, from whatever source, and on occasion to cause a deliberate sideslip.

Of the lateral control Mr. Lankester Parker said he found it difficult to explain how it was judged. It must be powerful enough to trim the aircraft laterally at all speeds and with unsymmetrical loading (more fuel in one wing tank than in another) and to maintain course (opposite bank inducing sideslip) with the rudder fully applied. A laterally stable aircraft resists this, and the ailerons must be powerful enough to overcome this resistance.

After explaining the interaction of all three controls during a turn, Mr. Lankester Parker pointed out that nobody has yet succeeded in designing perfect controls. The aileron control should apply a rolling moment only, but it may, in fact, cause a yaw, or even a variation in total lift or drag. A rudder should affect yaw only, but may cause roll. An elevator should affect pitch only, but may affect lift as well. A test pilot must therefore be very careful to differentiate between cause and effect. For example, poor ailerons might properly cause a roll to starboard and a subsequent turn in that direction, but they might induce an unwanted yaw to port in the process. The test pilot should be able to tell the designer in such a case that the fault was not one of directional instability but of the lateral control.

The lecture concluded with a brief outline of performance testing.

R.A.F.'s "TOUGH TECHNICIANS"

THE tough technicians is an apt description of the R.A.F. Servicing Commandos, a picked body of highly skilled men who have volunteered for one of the most hazardous jobs of the war. When the Allied Expeditionary Force moves into Europe they will come into action as soon as sufficient ground has been obtained to lay down landing-strips. The Commandos will then move into service and keep in the air the fighter squadrons providing close support to the advancing troops. But they have also to be thoroughly trained fighting men, for in the event of a counter-attack they must be ready and qualified to take their part in the defence of airfields.

Although all the men are skilled tradesmen, it is not intended that they should confine themselves to their own trades. Being mobile they have to be versatile, and consequently all are proficient in refuelling and rearming any type of aircraft, and have attained a reasonable degree of proficiency in at least two trades besides the one in which they are specialists. In effect, in an emergency they can turn their hands to any job which is essential to keep the fighters in the air.

"The men volunteered purely out of a spirit of adventure, for there is no financial inducement offered with the job," said Flt. Lt. N. C. Farries, an engineering officer of 20 years' experience, who is C.O. of a typical Commando unit.

"They have to be tough and generally live rough," he explained. "The only trouble we have had with them has arisen out of their impatience to get into action."

International Air Operators Conference

A Permanent Organisation Established : Lord Grimthorpe Chairman of C.I.A.T.O.

THE conference of international air traffic operators which concluded its three days' deliberations under the very able chairmanship of Lord Grimthorpe last Friday was a definite success. To its sponsors, North-Eastern Airways, it must indeed be very gratifying that their efforts have not been in vain and that the conference has made so promising a start.

For the pre-conference stage was marked by much aloofness and hesitation; both the Air Ministry and the B.O.A.C. kept in splendid isolation, well-nigh ignoring the efforts made to convoke the conference. It is presumably because of this attitude that some major British and Empire interests did not take part in this gathering, which might have appeared to them too bold.

But this shyness appears to have been not only the privilege of the non-co-operators; even those British companies which took part would not, it seems, come into the open, their names remaining discreetly behind a screen of secrecy. And if in the case of operators from enemy-occupied countries this secrecy was attributed to some obscure security reasons, this was certainly not applicable to British companies represented. One is forced to ask oneself if this shyness of press limelight, particularly as the name of at least one company, North-Eastern Airways was mentioned, was not dictated by a nervous apprehension in face of the official attitude and the desire to please everybody.

GETTING DOWN TO BUSINESS : Lt. Col. the Rt. Hon. Lord Grimthorpe, Chairman of the conference, opens the proceedings.

Of the twenty-six companies represented at the conference and hailing from fourteen countries, six were British. The representatives of Russia, China and of the two present American companies, the T.W.A. and American Export Lines were observers and not active delegates.

From the list of countries represented, comprising Belgium, China, Czechoslovakia, Denmark, France, Great Britain, Greece, Norway, Poland, Sweden, Switzerland, U.S.A., U.S.S.R. and Yugoslavia, it is evident that a number of fully participating delegates were from pre-war Government-controlled enterprises.

Throughout its sessions a friendly spirit prevailed during the conference, demonstrated by the unanimous resolutions made. This, despite the fact that the driving motives which brought the many companies together might have been somewhat different. For while the initiators and their British colleagues may have desired to demonstrate their existence in face of, and in advance of, some future shaping of aviation policy, the foreign representatives came, perhaps, to the conference wishing to remind the world of their past existence, glad to find a forum upon which to assert their claims to a share in post-war aviation. The all too prevalent suspicion that countries which have developed their aircraft industry and air power during this war might endeavour to monoplise future air transport was doubtless a factor.

The conference was clearly no place for ventilating anybody's grievances or apprehensions as to the future air policy of the British Government. The foreign companies would have recoiled from the prospect of getting involved in a delicate matter of domestic policy. And although some views on future air policy were exchanged, the conference wisely steered clear of issues of major politics.

So much for the background. The significance of this conference lies in two aspects: first, for the first time since the outbreak of war representatives of air traffic operators have come together to discuss their problems. And while surely the future of air transport is of as much immediate concern to the man in the street as it is to those who are in this line of business, the fact that the latter have started to co-operate may augur well for the future.

Secondly, the conference decided to establish a permanent organisation under the name of Conference of International Air Traffic Operators, the C.I.A.T.O., the future membership of which is apparently not to be limited to operators of international air lines. Lord Grimthorpe was elected chairman for the ensuing year.

Of special importance is the Conference's decision to suggest to the United Nations' Governments that they set up an international committee to deal with the question of making transport aircraft available to the air line companies, and that the latter should be represented on an advisory sub-committee of this committee; the Conference considered that equipment to be provided should be at least equal to what they had before the war so that they may resume their operations as soon as possible after hostilities cease. From the phrasing of this resolution one gathers the desire of air transport operators to pick up the threads with the past and to continue their existence as independent bodies as well as their apprehension as to the availability of aircraft for civil transport.

For, quite obviously, no matter how efficient and how well-planned their future operations or how sympathetic the attitude of Governments, if aircraft is not made available, there will be no flying. The apprehension is of course for the transitory stage, before civil aircraft becomes normally available, and while the envisaged objective is to secure aircraft on some basis or other. It surely embraces a suggestion for allocation of aircraft of such reparations as may be imposed upon the enemy In this there is both justice and expediency. If the desire to make aviation a real instrument of peace will guide them, the C.I.A.T.O. with all its cumulative experience and knowledge may well be in a position to render good counsel.

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The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

INFORMATION LEAKAGE

Adverse Criticism Deplored

IN reply to "Ex-A.T.C. and R.A.F.," I agree with him that adverse criticism of the A.T.C. is to be deplored, but why does he immediately—both directly and by inference—attack the Royal Observer Corps?

Members of this Corps, both men and women, do, on the whole, a sometimes difficult and often very monotonous job very well; many "B" class observers do their ordinary civilian work with the added burden of three out of four broken nights' sleep per week (if they do six-hour shifts of duty).

"The large numbers of young men in its ranks" (to quote your correspondent) have an average age in my own Post of over 50, more than half of whom were in the Services during the last war.

We do *not* have access to "great amounts of unpublished data," and security is certainly not being infringed more by them than by other units of Civil Defence or the Forces; it is, on the contrary, being constantly stressed.

R.O.C., SUSSEX.

A Very Serious Accusation

AS a member of the R.O.C. I feel I must reply to the letter headed "Too Much Useless Criticism" (*Flight*, April 20th), over the *nom de plume* "Ex-A.T.C. and R.A.F."

A very serious accusation has been levelled by him at the Corps to which I have the honour of belonging, namely, that he believes there is a leakage of information which comes from the R.O.C., as the R.O.C. has access to a far greater amount of unpublished data than, presumably, the A.T.C., which leakage of information appears probably to come from the LARGE (capitals mine) number of young men among its ranks.

Was "Ex-A.T.C and R.A.F." ever a member of the R.O.C.? If not, how is he in a position to know about the R.O.C. I have been a civilian instructor to the A.T.C. in the subject of aircraft recognition and can definitely say that, unfortunately, the A.T.C. is ahead of the R.O.C. in instructional matter and A.F.1480s.

Further, I should like to point out that members of the R.O.C., in this group anyway, are mostly men with last war service aged between 45 and 60, and as they have all reached the years of discretion (can this be said of the A.T.C.?) I venture to suggest that they know how to hold their tongues about anything new or secret in the aircraft line.

I, too, join "Ex-A.T.C. and R.A.F." in his hopes for less useless criticism, not only of the A.T.C. but of most things.

In closing, I would ask him to practise what he preaches, and if mud has been slung at him, suggest his slinging it back, but not on to others.

AN R.O.C. MEMBER.

Only Silhouettes Supplied to R.O.C.

AS both an A.T.C. and R.O.C. instructor, I think I am qualified to elaborate on your correspondent "Ex-A.T.C. and R.A.F." of April 20th.

It is not generally known that the only information supplied to both movements consists of silhouettes. In the case of the A.T.C. these are handed to the instructor, who is following a set syllabus. Unpublished types are included, but should one be unwarily produced in class, details are confined to the silhouette and the aircraft name. Cadets are unable to find operational particulars of such a machine *within the A.T.C. itself*.

In the case of the R.O.C., who have to know the shape of everything in the air, similar silhouettes are received which are, again, handed to the post instructor. It is essential that such silhouettes should be studied by all in the Corps, but information regarding the types stops at that. Instructors receive but the barest details of any new design likely to be seen flying, and certainly no operational particulars. They are only concerned with what the aircraft looks like. Incidentally, the statement regarding the "large number of young men" in the R.O.C. ranks is incorrect. There are some, but the personnel consists mainly of retired Service people and others over thirty.

Anyone with eyes can see plenty of new stuff flying these days, but open discussion by members of the A.T.C. or R.O.C. as to the capabilities of a secret aircraft shows a healthy air-mindedness, and must not be taken to infer that either have access to mines of information about them. It is not so.

During three years of instructing in both movements almost every case of violated secrecy brought to my notice originated from persons unattached to them. The R.O.C., the A.T.C. and their cousins the "Jim Crows," are too interested in the job on hand to jeopardise it, and I stress again that none of them is supplied with operational secrets by the Air Ministry. How about the thousands of M.A.P. civilian clerks "in the know," or the army of temporary newcomers to the aircraft industry?

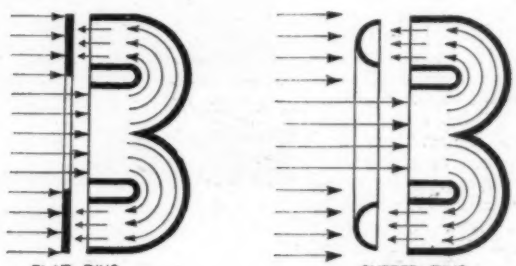
"BOTH SIDES."

THE DUCTED RADIATOR

Unnatural Behaviour of the Townend Ring

IT seems to me that the simplest explanation of the apparently unnatural behaviour of the T.R. is that a portion of the air, viz., that part passing through the centre, is, by means of a suitably designed object, directed in such a way as to produce a forward thrust.

If we take a simple flat ring in which the area of the hole is larger than the surrounding surface and place this ring in front of a flow-reversing chamber (see sketch), the thrust of the reversed draught will exceed the direct thrust from the front. If instead of a flat ring a cupped one is used, this effect will be enhanced.



It is therefore evident that the chamber or any other body producing forward thrust is an essential part of the system, and the ring is only the recipient of the thrust and reacts accordingly. If the two parts were fastened together, as they are in practice, and the whole system exposed to the airstream, it would, of course, move backward, not forward. The forward thrust on the ring is produced at the expense of a backward thrust on the body behind it which deviates the airflow.

It is a case of the roundabouts and the swings; in fact, due to friction, we lose more than we gain.

"DRAUGHTSMAN."

THE FUTURE OF CIVIL AVIATION

Reconsideration of Suggested Types

AFTER reading through the excellent review of my paper on "The Future of Civil Aviation," which appeared in *Flight* for May 4th, I feel that it might avoid possible misconceptions if I add a note of explanation in regard to the tabulations of suggested types of aircraft for future operation.

On page 482 I gave a list of six types which I thought might be proceeded with immediately after the war for operation during the second five-year period. This list, which is a purely personal one, unrelated to the recommendations of the Brabazon Committee, may appear disappointing and unimaginative, but I have taken the view that it is vital to work on a series of sound, conventional types which can be brought into operation quickly. In my view passenger machines of over 30,000 lb. all-up weight with only two engines will not be acceptable in a few years' time, and, bearing in mind also that excellent American types of similar size already exist, I feel it would be better for us to concentrate on a good four-engined design, reserving twin engines for large freight machines, to which they are better suited. I feel that we are not in a position to tackle a really big machine at this stage, and in the tabulation

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I have gone no farther than 160,000 lb. Although elsewhere in the paper I recommended not exceeding four airscrew centres, I departed from this for the 160,000 lb. machine as a necessary compromise to utilise existing engines. The tabulation, intended for production series, shows no jet-type machines, but I feel strongly that two or three experimental types for really high speed, but short range, should be put in hand as prototypes as soon as possible in this first five-year period in order to gain rapid experience of this new prime mover for civil work.

The second tabulation on the same page listed four more ambitious machines which I thought might follow for operation in the third five-year period. Doubtless at this time there will be scope for a much larger variety, but I have only given these as typical examples of what I think we might aim at. The first two machines shown would be powered with gas turbines driving airscrews, would embody new design technique, and would have a high performance for moderate range. Other turbine types would follow as a result of the experience gained with the experimental jet types already recommended for design in the first five-year period. The other two machines are intended for transoceanic operation, and would be fitted with new high-power piston-type engines, although they might have turbines later. I have shown the flying boat much larger than the land plane, and in view of the present uncertainty as to where in the new programme the flying boat of the future comes into the picture it might have been better to make them both of the same weight in order to obtain an exact comparison. Whether or not this is so, I feel that a large flying boat experiment is definitely needed and that some such craft should be produced as quickly as is feasible; and that, taking all circumstances into consideration, it would be better to make a big step in this case.

A. H. ROY FEDDEN.

A.T.C. OFFICERS' DRESS

Branded as "Poor Relations"

AS a last-war pilot and the commanding officer of one of the first A.T.C. squadrons which was formed as an A.D.C.C. unit over five years ago, perhaps I may be permitted to comment on the letter you published on April 6th.

Wherever A.T.C. officers congregate one hears the universal complaint that the Air Ministry is making our work very much more difficult by its differentiation between officers of the Training Branch of the R.A.F. and all their brother officers, and the uniform anomalies are one of the chief sources of the trouble. For three years we were branded as the poor relations of the full-time R.A.F. officers by the ridiculous "taxi driver" badges on our sleeves, and the decision to abolish them this month was hailed as a step in the right direction. But our approval has been changed to annoyance by the short-sighted regulation which permits us to wear peaked caps for the first time, but only when we are off parade. What is the point of such a meaningless concession, for officers of the Training Branch are permitted to wear their uniforms only on parade or when proceeding to and from parades?

It is high time that the Air Ministry realised that A.T.C. officers, who are often putting in long hours at their civilian jobs, are, in addition, doing exactly the same work as the officers at Initial Training Wings, the only difference being that the A.T.C. officer is unpaid. By making us dress differently the authorities are putting us in an inferior position to other R.A.F. officers and consequently we are often treated differently when we visit R.A.F. stations.

There are black sheep amongst us as there are amongst all Service officers, but the conscientious, efficient officers feel a sense of humilation when it appears that the Air Ministry seems determined to single out A.T.C. officers by some special uniform regulations. Whereas other R.A.F. officers are ordered to wear their peaked caps on formal occasions, the reverse is to be the case with us.

Your correspondent alleged that it is a matter of personal vanity that we should wish to wear the peaked cap. He is as misinformed as is the Air Ministry. Those of us who served in the R.F.C. were proud in the old days to wear the regulation field service cap. I am a Home Guard officer and have no qualms about wearing the forage cap, for is it not the uniform dress of all Army officers when in battledress?

It is high time that the Air Ministry issued orders to all officers commanding R.A.F. stations that officers of the Training Branch are to be regarded as of equal status as all other R.A.F. officers. The great majority of Service personnel show us the respect our commissions deserve, but I know by personal experience that it is by no means universal.

The cadets, too, in my opinion, have a grievance. Whereas their brothers in the Army Cadet Force wear a similar uniform to that of the soldier, A.T.C. cadets have tunics which button up to the neck and, unlike the Army Cadets, they have no issue of greatcoats or boots, and many have to buy black boots in consequence.

One last point. A.T.C. officers are usually putting in as many hours as those in the Home Guard, and as one who serves in both forces I at any rate think that my A.T.C. work is just as valuable to the national cause as anything I do with the Home Guard. But the honours conferred on A.T.C. officers are quite negligible when compared with those distributed amongst H.G. officers.

I am afraid that the Air Ministry thinks that as we are working amongst boys, we do not count for very much, but 80 per cent. of the R.A.F. intake now comes from the A.T.C., and it is only fitting that its officers should be put on the same footing as the others commissioned in the R.A.F.

FLT. LT. R.A.F.V.R.(T).

THE HEAVY BOMBER

An Indispensable Quality

YOUR correspondent Mr. Barty, in his second communication (*Flight*, April 27th), persists again in ignoring a further vital requirement in the "function of a good heavy bomber" without the possession of which the other qualities are wasted. I refer to the ability to fight through to the target and, after dropping the bomb-load, fight back to base. Without this ability long range, heavy loading and great speed are worse than useless.

The heavy bombers of the U.S.A.A.F. have this quality in a high degree and, far from being out-of-date as alleged by Mr. Barty, are in fact the most efficient in the world to-day for their particular function, as an examination of available statistics and the use of a little of the common sense urged upon others by your correspondent will show quite clearly.

Concerning Mr. Barty's remarks regarding the relative efficiency of U.S. and British bomb sights, one cannot argue, as his remarks must obviously be out of order in view of the fact that information is not yet released.

On the question of the smaller bomb-load carried by the Fortress, however, it ought to be apparent to most thoughtful people that bombs must necessarily yield some room to the extra guns, ammunition and gunners necessary to fight through on daylight missions.

J. A. RHIND.

STATUS OF DRAUGHTSMEN

Formation of an I.E.D. Suggested

IN view of the present elasticity of the definition of the word "Draughtsman," I should be pleased if it would be possible for you to give publicity to a suggestion which I should like to make regarding the formation of an "Institution of Engineering Draughtsmen."

I feel that the existence of such a body, requiring from its members set standards in practical and technical qualifications, as well as a minimum period of draughting experience, could serve only a good purpose.

I suggest that the aim of such an institution be:—

(1) To raise the status of draughtsmen.

(2) To bring draughtsmen together in the manner of the professional engineering bodies by means of debates, lectures and industrial visits, etc., etc.

(3) To encourage young draughtsmen by practical recognition of their technical successes at an earlier date than would be the case with the professional bodies.

Members could be graded as follows:—

(*a*) *Fellow:* Fellowship would be offered to eminent designers, especially those who had encouraged their draughtsmen to improve their technical knowledge and also endeavoured generally to raise the status of draughtsmen.

(*b*) *Members:* Members would be draughtsmen having passed the Associate Membership Examination of their respective engineering bodies (Mechanical, Civil, Electrical, Structural, etc., etc.), being the minimum age of thirty years, and having had three years' workshop and ten years' draughting experience.

(*c*) *Associate Members:* Associate Members would be required to have attained the age of twenty-five, possess the Higher National Certificate in Mechanical or Electrical Engineering, and have had three years' workshop training and six years' draughting experience. Associated membership could be open also to draughtsmen of the minimum age of thirty-five having had the prac-

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tical experience required for a full member, and equivalent technical training to that for a National Certificate (Higher Grade). This could be a temporary arrangement of, say, three years' duration made in fairness to men who underwent their technical training when National Certificates were in their infancy.

(*d*) *Graduates:* Graduateship would be open to juniors aged twenty-one to twenty-five with three years' workshop and three years' drawing office training. Technical qualifications would be the Lower National Certificate in Mechanical or Electrical Engineering.

Indentures or testimonials could be asked for for all grades excluding the first.

It could be asserted that the work of such a body is performed already by the professional engineering institutions. To this I would reply that associate membership of the institutions quoted in (*b*) is not thrown open to draughtsmen generally. Meetings of the institutions, too, are more or less monopolised by the full members

The greatest advantage that such an institution could offer would be in the encouragement of juniors. It is a fact that the prospect before one in his third year of a National Certificate course is rather bleak, with two years' more work before attaining the Higher National Certificate and then approximately two years further before taking the outstanding examinations of the A.M.I.Mech.E. diploma. The admission to graduateship would thus be a reward and an incentive to further efforts. Present possession of the National Certificate is in itself often a qualification which seems to put one only on the level of the junior whose sole excursion into a technical college is on a social occasion.

I cannot make it too clear that the inauguration of such an institute must not be allowed to infringe on the functions of the A.E.S.D., a commendable body whose aims definitely lie towards a different goal from that outlined above. It would be interesting to ascertain whether there is a general desire for such an institution.

I have attempted to outline my ideas of the qualifications necessary for the various grades, and while doubtless exempting examination could be accepted in lieu of National Certificates, I am of the opinion that indiscriminate lowering of the standards of entrance would be the rock on which the organisation would founder. The finances of such a body are not at the moment relevant. ARTHUR R. SHORT.

JET PROPULSION FOR AIRCRAFT

Unfortunate Comparison with Rockets

IT is, to my mind, unfortunate that J.P. aircraft are so often compared with rockets. The two problems are no doubt related in that propulsion is derived in both cases from direct reaction, but there the comparison ends. First, the rocket carries all its propellant, oxygen included in most cases, in the form of a combustible mixture which allows it to function even in the upper layers approaching vacuum, whereas the J.P. turbine, as yet the only practical source of power for this form of flight, manufactures its propellant by borrowing the greater part of the mixture from the atmosphere, which in turn precludes flight in the upper layers where the mass of fuel burnt exceeds the mass of air used in burning it.

Secondly, the rocket is launched primarily at an angle approaching 180 deg. to gravitational pull and relies solely on reaction drive to overcome " g " until it reaches the desired height where " g " immediately takes charge and returns it to earth. As against this, aircraft are launched at 90 deg to gravitational pull and rely as much on the lift coefficient of the wing as on the method of propulsion to overcome " g." Cut off the fuel in flight and the rocket is a helpless object, but any aircraft, J.P. or conventional, will still have a useful gliding function, and this introduces totally different considerations.

Thirdly, the rocket has to lift only itself and at best an explosive charge or a few meteorological instruments, whereas aircraft are essentially a means of economic or military transport with a payload of passengers, freight or armament.

Now for a few observations on recent articles and correspondence, some of these points having been made by implication if not by direct reference:—

Intake suction.—This occurs only when the aircraft is on chocks and the turbines are running up. As soon as the aircraft is in motion the ramming effect comes into play. This was most admirably dealt with by your cartoonist on page 141, February 10th, 1944. If suction were the main source of power, how would rockets fly, but then we should not compare them. By the way, the inlet speed Vi should not be taken as aircraft speed V, because of suction when at rest and ramming effect in flight. The small difference is explainable according to Bernouilli, for if we tap by suction (at rest) a source of air at atmospheric pressure, then the suction lowers that pressure near the intake and speeds up the air from O to Vi, and the ramming effect (in flight) increases the pressure whilst decelerating the air from V to Vi, and any absolutely correct calculation should take this into account.

Thrust.—This is, of course, greatest when the aircraft is on chocks and the turbines are raced. Conversely, it is least when the aircraft is at full speed, i.e., when its efficiency is at the top of the curve, and it responds to the smallest momentary or continuous impulse. The ideal condition would be attained when aircraft speed and jet speed are equal in opposite directions in relation to the surrounding atmosphere. Good-bye skin friction and drag! But again this means that the whole of the acceleration is imparted to the aircraft and none to the incoming and outgoing gases, i.e., pure rocket flight when we started with a turbine.

Combustion.—There should be some interesting experiments in fuel selection. For the information of " Driver " (*Flight*, March 11th) and J. R. Gould (March 30th), there was some work done in 1936 or 1937 in so-called harnessed explosives, where the conversion into gas was so decelerated as to occur in 1/25th of a second instead of an infinitesimal fraction. The inventor suggested using these tame explosives for raising hulks, breaking up coal seams, spraying liquid concrete on to incendiaries, and catapulting aircraft.

J.P. Battleships.—A. L. Ward (*Flight*, February 17th) should ask himself first what power is required to propel 35,000 tons of metal at 30 knots. The answer is around 200,000 h.p. Next he can calculate at the rate of 0.0765 lb/cu. ft., how many cubic miles of air his blower must throw back to exert by direct reaction a similar thrust, and then how many battleships it would take to carry a blower that size. Putting it another way, take the sail area of a 2,000-ton 4-master at 15 knots, a good spanking speed, and transform that into the blade area of your blower. The answer is, of course, that jet propulsion is possible, provided the effluent is borrowed from, or of comparable mass to the medium it has to overcome, in this case water.

Boundary Layer.—In your article of March 9th you show the layer of turbulence spilling over into a duct at right angles. You also state that such a duct could supply the blower intake of conventional or turbine plant. I suggest that this is inefficient on two counts, first, that positive sucking off of the turbulence as shown in the Bristol project or by means of an ejector ring round the turbine nozzle would achieve a far greater effect, and, secondly, that spilled air is at low pressure and provides no great ramming effect so useful in blowers and particularly for J.P. And an ejector ring is the same as a thrust augmentor and would considerably assist for J.P. take-off, whilst a simple shutter will cut it out for approach when increased drag is required.

While on the subject of boundary layer and battleships, with up-to-date rotary pumps, deriving their source from large I.C. turbines, and with the water intakes suitably placed along the hull to break up the turbulence where it is most harmful, we may yet see J.P. dreadnoughts cruising alongside M.T.B.s.

Cooling v. Heating.—" Projet " (*Flight*, March 23rd) takes objection to the " cooling air ducts " in your turbine power egg, and you return valiantly to the fray with a suggestion in your latest article of preheaters by convection the better to confound him. This, of course, is quite correct, for it is clearly your intention to preheat the air as much as possible before combustion, thereby saving fuel, but to cool the walls of the combustion chamber and turbine to save material in the long run, and I suggest that " Projet " has simply misread " cooling-air ducts " and visualised " air-cooling ducts."

LAYMAN, UNQUALIFIED.

New Edition.

Gas Turbines and Jet Propulsion for Aircraft

By G. GEOFFREY SMITH, M.B.E.

A THIRD and enlarged edition of this "FLIGHT" book with illustrated descriptions and comments upon the varying forms of steam and gas turbine-compressor units, is now on the press, and will be available shortly. Fifteen chapters and many new drawings are included. In this latest edition the original chapters have been retained with modifications and additions. The joint official announcement of the R.A.F. and U.S.A.A.F. has made it possible to extend due credit to the inventive genius and pioneer work of British technicians who developed gas turbine units to a practical stage for aircraft. There is a foreword by Sir Geoffrey de Havilland.

Orders for this third edition which is priced at 6/- or 6/4 by post, will be executed in rotation, and should be addressed to—

Flight Publishing Co. Ltd., Dorset House, Stamford Street, London, S.E.1

A Lancaster III on a daylight test flight above the clouds.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News and Announcements

Appointments

AIR COMDRE C. McC. VINCENT, D.F.C., A.F.C., has been appointed Commandant of the Empire Central Flying School in succession to Air Comdre. G. S. Oddie, D.F.C., A.F.C., who has played a notable part in the development of the school in its Empire status. Appointed as Chief Instructor at the school is Group Capt. H. A. V. Hogan, D.F.C.

Air Comdre. Vincent was one of the pioneers of the wireless-controlled aircraft, and helped to evolve the Fairey Queen, the first successful type. The Queen Wasp and Queen Bee followed. Group Capt. Hogan, a Battle of Britain pilot, took part in the famous non-stop flight by Vickers Wellesleys from Ismailia to Australia, when a record of 7,162 miles was set up. Unfortunately, Group Capt. Hogan's aircraft had to come down at Koepang, Timor, to refuel.

Promotions

GENERAL DUTIES BRANCH.

Air Vice-Marshal A. LEES, C.B., C.B.E., D.S.O., A.F.C., is granted the rank of Act. Air Marshal. April 8th, 1944.

Air Commodores are granted the rank of Act. Air Vice-Marshal :—

A. P. DAVIDSON, C.B.E., March 29th, 1944.

W. A. B. BOWEN BUSCARLET, C.B.E., D.F.C., March 26th, 1944.

R. O. JONES, C.B., A.F.C., June 9th, 1943.

Retirement

GENERAL DUTIES BRANCH.

Group Capt. (temp. Air Comdre.) E. D. JOHNSON, A.F.C., is placed on the retired list and retains the rank of Air Comdre. April 21st, 1944.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy :—

Bar to Distinguished Service Order

Act. Sqn. Ldr. H. B. MARTIN, D.S.O., D.F.C., R.A.F.V.R., No. 617 Sqn.—Since being awarded a Bar to the D.F.C., this officer has completed numerous sorties and has continued to set the highest example of courage and devotion to duty. He is a brilliant and fearless leader, whose iron determination in the face of the fiercest opposition has won great praise. One night in February 1, 1944, Sqn. Ldr. Martin captained an aircraft detailed to attack a target in southern France. During the run-up to the target his aircraft was repeatedly hit. One member of the crew was killed and another one was wounded. Sqn. Ldr. Martin pressed home his attack, however, and afterwards flew the damaged bomber to an airfield, where he effected a masterly landing in difficult circumstances. He displayed great skill and resolution throughout.

Distinguished Service Order

Act. Wing Cdr. W. H. SWETMAN, D.F.C., R.C.A.F., No. 426 (R.C.A.F.) Sqn.—This officer has completed two tours of operations, during which he has attacked most of the enemy's heavily defended targets in Germany, including six on the capital city. He has always endeavoured to press home his attacks with the greatest determination, and his example of courage and devotion to duty has inspired all. Wing Cdr. Swetman is a dauntless leader, whose able and untiring efforts have been reflected in the fine fighting qualities of the squadron he commands.

Wing Cdr. J. H. GRESWELL, D.F.C., R.A.F., No. 179 Sqn.—Wing Cdr. Greswell, now on his third tour of operational duty, has taken part in a large number of operational sorties. Both in the air and on the ground, he has set a magnificent example of keenness and devotion to duty to his squadron.

Act. Wing Cdr. C. V. D. WILLIS, R.A.F., No. 192 Sqn.—Since being awarded the D.F.C., this officer has completed a large number of sorties, many of them demanding skill of a high degree. His appreciation of the responsibilities entrusted to him, his ingenuity and his determination to complete his allotted task have contributed in a large measure to the success of the operations in which he has taken part. He is a fine leader, whose example of courage and devotion to duty has been worthy of the greatest praise.

P/O. H. H. Adams, who has been awarded the D.F.C.

Bar to Distinguished Flying Cross

Act. Wing Cdr. I. J. SPENCER, D.F.C., R.A.F.O.—Wing Cdr. Spencer has completed numerous sorties since the award of the D.F.C. In August, 1943, he led his flight with commendable efficiency to attack the Naval depot at Rennes. While over the target, his aircraft was badly damaged by anti-aircraft fire and the navigator severely wounded. Despite the damage, Wing Cdr. Spencer flew the aircraft safely to base. As a flight and squadron commander this officer has shown outstanding courage, leadership and enthusiasm.

Act. Sqn. Ldr. H. E. TAPPIN, D.F.C., R.A.F.V.R., No. 157 Sqn.—Since being awarded the D.F.C. this officer has flown on many more operational sorties, during which he has destroyed one six-engine B.V.222 enemy flying boat and two enemy aircraft. On one occasion, when flying on patrol, Sqn. Ldr. Tappin intercepted and destroyed an He. 177. In the consequent air combat his aircraft was hit by fire from an enemy fighter and damaged. Nevertheless he pressed home another attack on a Ju. 88 which was lost in cloud cover. At all times this officer has shown a magnificent fighting spirit and grim determination, achieving his successes by careful planning and execution of every sortie.

Sqn. Ldr. G. C. KEEFER, D.F.C., R.C.A.F., No. 412 (R.C.A.F.) Sqn.—Sqn. Ldr. Keefer has always performed his duties with unfailing coolness and courage. On many occasions he has escorted

SERVICE AVIATION

large formations of bomber aircraft over enemy territory, achieving much success. Since the award of the D.F.C. he has continued to take part in operations with the greatest keenness, and has engaged the enemy many times.

Distinguished Flying Cross

P/O. J. S. LEECH, R.N.Z.A.F., No. 158 Sqn.
Act. Group Capt. G. F. K. DONALDSON, A.F.C., R.A.F.O.
Act. Flt. Lt. W. ADAMS, R.A.F.V.R., No. 149 Sqn.
Act. Flt. Lt. L. J. HALLEY, R.A.F.V.R., No. 115 Sqn.
F/O. G. D. Le M. SEDDON, R.A.A.F., No. 115 Sqn.
F/O. B. T. FOXLEE, D.F.M., R.A.A.F., No. 617 Sqn.
F/O. S. HALLIWELL, R.A.F.V.R., No. 61 Sqn.
Act. Wing Cdr. H. S. GRIMSEY, R.A.F.V.R., No. 105 Sqn.
Act. Sqn. Ldr. E. F. PILLEY, R.A.F.V.R., No. 70 Sqn.
Flt. Lt. D. GILES, R.A.F.V.R., No. 255 Sqn.
Flt. Lt. L. M. MASON, R.A.F.V.R., No. 70 Sqn.
Flt. Lt. J. P. MILLS, R.A.F.V.R., No. 73 Sqn.
Act. Flt. Lt. G. W. CHATTINGTON, R.A.F.V.R., No. 70 Sqn.
F/O. M. B. H. CHALLIS, R.A.F.V.R., No. 37 Sqn.
F/O. R. W. HENDERSON, R.A.F.V.R., No. 92 Sqn.
F/O. R. D. SCRASE, R.A.F.V.R., No. 72 Sqn.
F/O. C. W. WILSON, R.A.F., No. 70 Sqn.
P/O. H. W. T. BATES, R.A.F.V.R., No. 14 Sqn.
P/O. F. M. DRAKE, R.A.F.V.R., No 255 Sqn.
P/O. K. F. BOULTON, R.A.F.V.R., No. 153 Sqn.
W/O. W. A. D. ARMSTRONG, R.A.F.V.R., No. 14 Sqn.
Flt. Lt. L. MCINTOSH, R.A.A.F., No. 111 Sqn.
F/O. E. J. ELLIOTT, R.A.A.F., No. 104 Sqn.
P/O. G. R. ANDERSON, R.A.A.F., No. 150 Sqn.
W/O. J. T. CONNOLLY, R.A.A.F., No. 72 Sqn.
Act. Sqn. Ldr. G. B. OUGH, R.C.A.F., No. 458 (R.A.A.F.) Sqn.
Act. Flt. Lt. F. J. RODDICK, R.C.A.F., No. 262 Sqn.
F/O. C. L. HEIDE, R.C.A.F., No. 39 Sqn.
F/O. W. E. SCHRADER, R.N.Z.A.F., No. 1435 Sqn.
Flt. Lt. S. W. BUTLER, R.A.F.V.R., No. 422 (R.C.A.F.) Sqn.
Act. Flt. Lt. J. C. W. WELLER, R.A.F., No. 630 Sqn.
F/O. T. D. SIMPSON, D.F.M., R.A.A.F., No. 617 Sqn.
2/Lt. N. B. GOULD, S.A.A.F., No. 15 (S.A.A.F.) Sqn.
P/O. K. ROBERTS, R.A.A.F., No. 619 Sqn.
Act. Sqn. Ldr. M. I. BOYLE, R.A.F.V.R., No. 57 Sqn.
Flt. Lt. W. A. BETTS, R.A.F.V.R., No. 199 Sqn.
Flt. Lt. T. H. BLACKHAM, R.A.F.V.R., No. 50 Sqn.
Flt. Lt. B. C. KITCH, R.A.F.V.R., No. 61 Sqn.
Flt. Lt. F. H. PHILLIPS, R.A.F.V.R., No. 44 Sqn.
Act. Flt. Lt. I. RADEMEYER, R.A.F.V.R., No. 44 Sqn.
Act. Flt. Lt. E. N. THOMPSON, R.A.F., No. 77 Sqn.
F/O. V. H. TRIMBLE, R.A.A.F., No. 463 (R.A.A.F.) Sqn.
P/O. H. N. DAVIES, R.A.F.V.R., No. 44 Sqn.
Act. Flt. Lt. R. A. P. H. DUTTON, R.A.F.V.R., No. 259 Sqn., F/O. SEDDON, R.A.A.F., No. 259 Sqn.
Act. Sqn. Ldr. E. P. G. MOYNA, R.A.F.V.R.
Act. Flt. Lt. G. G. SUTHERLAND, D.F.M., R.C.A.F., No. 428 (R.C.A.F.) Sqn.
F/O. H. C. BRYANT, R.A.F.V.R., No. 514 Sqn.
F/O. C. F. RIDGERS, R.C.A.F., No. 408 (R.C.A.F.) Sqn.
F/O. D. J. TURNER, R.A.F.V.R., No. 248 Sqn.
P/O. D. A. BERRY, R.C.A.F., No. 426 (R.C.A.F.) Sqn.
P/O. F. GRIFFITHS, R.A.F.V.R., No. 619 Sqn.
P/O. J. R. MORRISON, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
P/O. R. N. MULLINS, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. W. C. A. PAY, R.A.F.V.R., No. 432 (R.C.A.F.) Sqn.
P/O. H. SHERLOCK, R.A.F.V.R., No. 408 (R.C.A.F.) Sqn.
Act. Flt. Lt. H. R. ROWLANDS, R.A.A.F., No. 213 Sqn.
F/O. C. F. BULL, R.C.A.F., No. 38 Sqn.
F/O. C. B. URWIN, R.A.F.V.R., No. 38 Sqn.
W/O. J. M. O'LEARY, R.A.F.V.R., No. 114 Sqn.
F/O. W. N. T. RUSSELL, R.A.A.F., No. 466 (R.A.A.F.) Sqn.
Act. Sqn. Ldr. R. A. WILLS, R.A.A.F., No. 236 Sqn.
Flt. Lt. H. J. EVERARD, R.C.A.F., No. 417 (R.C.A.F.) Sqn.
Act. Flt. Lt. W. G. BARNES, R.A.F.V.R., No. 10 Sqn.
F/O. L. F. M. CRONIN, R.A.A.F., No. 81 Sqn.
P/O. J. CHATTERTON, R.A.F.V.R., No 44 Sqn.
P/O. J. A. SANDERS, R.A.F.V.R., No. 49 Sqn.
Act. Wing Cdr. P. R. HATFIELD, R.A.F., No. 95 Sqn.
Wing Cdr. H. R. A. EDWARDS, A.F.C., R.A.F., No. 53 Sqn.

Conspicuous Gallantry Medal (Flying)

Flt. Sgt. H. A. DONALDSON, R.A.F.V.R., No. 199 Sqn.—This airman was the wireless operator of an aircraft detailed for an attack on a target in March, 1944. Soon after crossing the enemy coast, the aircraft was hit by fire from the ground defences. Flt. Sgt. Donaldson was hit in the leg by fragments of shrapnel, which lodged against the bone, causing a most painful wound. Despite this, he acted with great promptitude in assisting to extinguish a fire which had commenced in the aircraft. He afterwards set to work to repair his wireless apparatus, which had sustained damage. Not until this task was successfully completed did Flt. Sgt. Donaldson report his injury. Later on, the aircraft again came under fire and received further damage. Although in considerable pain, Flt. Sgt. Donaldson made light of his injuries, and remained at his post to execute his wireless duties until the sortie was completed. He displayed fortitude, courage and devotion to duty of a high order.

Distinguished Flying Medal

Flt. Sgt. R. A. MORRISON, R.A.F., No. 228 Sqn.
Flt. Sgt. J. F. MUNDY, R.A.F.V.R., No. 172 Sqn.
Flt. Sgt. R. A. PERRY, R.A.F.V.R., No. 415 (R.C.A.F.) Sqn.
Flt. Sgt. F. B. ROWLEY, R.A.F.V.R., No. 180 Sqn.
Sgt. N. BRUCE, R.C.A.F., No. 148 Sqn.

Air Comdre. C. McC. Vincent, D.F.C. and Bar, A.F.C., the new Commandant of the Empire Central Flying School.

Group Capt. H. A. V. Hogan, D.F.C., who has been appointed to be Chief Flying Instructor of E.C.F.S.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy in the South West Pacific area:—

Royal Australian Air Force

Distinguished Service Order

Wing Cdr. G. H. STEEGE, D.F.C.

Distinguished Flying Cross

Sqn. Ldr. B. HONEY.
Sqn. Ldr. R. H. THOMPSON.

Royal New Zealand Air Force

Distinguished Flying Cross

Act. Sqn. Ldr. P. G. H. NEWTON, No. 17 Sqn.
Act. Flt. Lt. J. J. A. de WILLIMOFF, No. 15 Sqn.
F/O. D. S. BEAUCHAMP, No. 6 Sqn.
F/O. A. G. S. GEORGE, No. 17 Sqn.
F/O. G. R. B. HIGHET, No. 6 Sqn.

THE KING has been graciously pleased to approve the following award in recognition of distinguished services:

Distinguished Conduct Medal

Flt. Sgt. (now W/O.) J. DOWDS, R.A.F., No. 83 Sqn.

Fleet Air Arm

THE KING has been graciously pleased to approve the following award:—

For outstanding enterprise and skill in piloting aircraft during hazardous aircraft trials.

M.B.E. (Mil.)

Temp. Lt. (A) E. M. BROWN, D.S.C., R.N.V.R.

Roll of Honour

Casualty Communiqué No. 381.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents, and natural deaths.

Of the names in this list, 150 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—F/O. H. Baker; P/O. J. A. Bartholomew; Sgt. G. H. Boffey; F/O. E. W. Carter; F/O. F. R. Daughton; P/O. R. W. Dickerson; Flt. Sgt. W. G. Duncan; Flt. Lt. R. S. Emerson; Sgt. G. K. Hall; F/O. A. W. Howell; Sgt. D. E. Jenkins; F/O. F. Jones; F/O. R. H. Lewis; Sgt. J. E. McCarthy; Flt. Sgt. A. J. Newell; Sgt. F. O. W. Pauley; Sgt. P. D. Rawson; Flt. Sgt. G. W. Wood.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sqn. Ldr. G. W. Holden, D.S.O., D.F.C.; Sgt. J. Raw; Sgt. T. S. Thomas; Sgt. A. Tice.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. L. T. Beck; Sgt. R. E. Bell; Sgt. T. I. Betts; Sgt. E. R. Bray; P/O. W. G. L. Brown; Sgt. W. R. Bryans; Sgt. D. Cameron; Sgt. G. L. Campbell; Sgt. J. Canning; Sgt. D. E. Cardwell; Flt. Sgt. N. P. L. Castells; Sgt. J. N. T. Chandler; Sgt. R. Cope; F/O. L. R. Crampton; Sgt. L. H. Croad; P/O. D. T. Davies; Sgt. J. Dodd; Sgt. J. Donaldson; P/O. R. K. Francis; P/O. E. M. Gold; F/O. J. F. Hanrahan; W/O. G. E. B. Hardman; Sgt. A. C. Harris; Flt. Sgt. J. Hawkes-Reed; Sgt. T. C. Herbert; P/O. H. W. Heron; Sgt. W. W. Hilditch; Flt. Sgt. G. L. Hill; Sgt. J. Hindley; F/O. L. H. Holmes; F/O. J. Howard-Bangs; Sgt. F. L. C. Kelly; Sgt. R. B. L. Kent; Sgt. G. J. Kynnersley; Flt. Sgt. G. W. A. Lambert; Sgt. K. R. Larkin; Sgt. J. L. Leader; Sgt. F. Lee; Sgt. H. Levine; F/O. P. H. Liddle; Sgt. J. T. Lloyd; Sgt. W. McElroy; F/O. F. MacKelden; P/O. J. H. McNess; F/O. H. Mappin; Sgt. R. A. Martin; P/O. C. E. Musto; Sgt. G. H. Newbolt; Sgt. S. A. J. North; F/O. H. D. Oates; Sgt. B. D. O'Neill; Sgt. S. F. Osmond; Sgt. D. A. Page; F/O. E. H. Patrick; Sgt. G. D. Prince; Sgt. R. D. Raven; Sgt. A. G. Rawlins; Sgt. J. Rees; Sgt. A. W. Richardson; F/O. J. E. Rigby; F/O. S. Roxburgh; Sgt. A. S. Scott; Sgt. D. Scragg; Sgt. R. M. Shepley; Sgt. R. A. C. Showler; F/O. A. R. Sinton; Sgt. R. V. Slater; Sgt. J. Smith; Sgt. R. A. H. Smith; Sgt. J. Stewart; Sgt. A. R. Stone; Sgt. J. W. Sykes; Flt. Sgt. A. G. Tanner; Sgt. P. J. Taylor; F/O. J. D. A. Tharp; Sgt. W. H. Thompson; Sgt. A. Thomson; Sgt. J. H. Thornton; Sgt. R. Toulson; Sgt. J. R. Tully; Act. Flt. Lt. J. A. Wakeford; Sgt. L. J. Wakerell; Sgt. A. C. Whiteman; Sgt. D. D. Williams; F/O. H. W. Woodsend; W/O. M. Woolcot; Sgt. R. J. Wyatt-Matthews.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. H. T. Spurrey.

WOUNDED OR INJURED IN ACTION.—Sgt. D. J. Jones; F/O. W. H. C. Ramsay.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. T. G. Dixon; Sgt. W. C. Hills.

MISSING, BELIEVED KILLED IN ACTION.—F/O R. Barr; Sqn. Ldr. K. G. Davis; Sgt. G. A. Fidler; W/O. R. Lidgate; F/O. P. J. McGuire; F/O. K. Marriott, D.F.M.; Act. Sqn. Ldr. G. B. Warnes, D.S.O., D.F.C.

MISSING.—Sgt. S. B. Appleton; F/O. T. R. Atkinson; Sgt. D. Austin; P/O. J. H. Baird; Sgt. C. T. Baker; Sgt. B. Baxter; Sgt. A. Chappell; F/O. C. L. Chappell; F/O. R. T. Cochrane; Sgt.

D. I. Cohen; Sgt. F. S. Coote; F/O. J. C. Corlett; Sgt. L. M. Cromwell; Flt. Sgt. H. Duckworth; Sgt. J. A. Ellery; Sgt. R. J. Farrell; Sgt. J. Fenton; Sgt. F. Fitzsimmons; Sgt. A. W. Fletcher; Act. Flt. Sgt. J. W. Goulbourn; F/O. A. D. H. Gray; F/O. K. A. Guiton; F/O. G. S. Hartley; Sgt. W. J. Hollis; Sgt. M. J. H. Jerrard; Flt. Lt. R. G. Long; F/O. E. N. McLeod-Nibbs; Wing Cdr. R. E. X. Mack, D.F.C.; W/O. G. Marsh; Sgt. H. W. Marshall; Flt. Sgt. D. K. Measures; Flt. Sgt. S. I. Miller; Sgt. D. A. Morling; P/O. F. E. N. Nice; Sgt. F. J. V. Pitcher; Sgt. R. F. Scarlett; Sgt. J. Slater; Sgt. A. R. G. Stewart; P/O. H. Tandy; Sgt. J. Tomlinson; Sgt. L. K. Topham; Flt. Lt. B. C. Townsin; Sgt. A. L. N. Vickery; Sgt. L. H. G. Weller; P/O. D. W. Whiting; P/O. J. M. Woodburn; P/O. A. E. Wright.

KILLED ON ACTIVE SERVICE.—Sgt. V. J. Ashmore; Flt. Sgt. F. R. Bennett; Sgt. G. H. Burke; Sgt. W. J. Constable; Sgt. W. Corner; L.A/C. F. L. Ford; Sgt. D. H. Hearton; Sgt. F. Hill; L.A/C. C. Kiley; L.A/C. J. A. Kinloch; Flt. Lt. J. T. Owen; Sgt. F. Plumpton; Flt. Sgt. M. A. Powell; L.A/C. T. M. Reid; Sgt. W. I. Roberts; Sgt. D. D. Roblin; F/O. E. Ryan; Flt. Sgt. R. H. Sharp; F/O. W. O. Thompson; Wing Cdr. P. F. Webster; F/O. C. J. Yates; Sgt. A. Younger.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. G. S. W. Gilbert; L.A/C. G. Harries; L.A/C. G. H. Helling; Sgt. P. W. Mister; A/C 1 R. J. Shove; Cpl. A. Ward; Sgt. H. J. Wilkinson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Cpl. A. Winter.

DIED ON ACTIVE SERVICE.—A/C.1 D. Anderson; A/C.1 J. W. Boon; Flt. Sgt. J. D. Bowers; A/C.1 J. Byrne; A/C 1 K. N. Gerrard; Cpl. E. Hall; Cpl. D. L. Hutton; L.A/C. P. H. Knight; Sgt. H. E. Prangnell; L.A/C. W. H. Tuckwell; Sgt. W. G. Woodford.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. W. N. Burton; F/O. A. Hassell; Flt. Sgt. E. V. Matthews; Sgt. A. E. Salt.

Women's Auxiliary Air Force

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/CW. M. Cocks; L.A/CW. M. A. B. Robb.

DIED ON ACTIVE SERVICE.—L.A/CW. G. I. Harding.

Royal Australian Air Force

KILLED IN ACTION.—F/O. F. A. Cleveland; Flt. Sgt. J. A. Dietman; P/O. G. A. Grant; Flt. Sgt. M. P. Jones; Flt. Sgt. E. H. Lawrie; F/O. I. Worth; Flt. Sgt. A. G. Young.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. R. M. Bryant; P/O. E. A. Dennis; Flt. Sgt. W. H. Fitzgerald; Flt. Sgt. R. G. Reu.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. I. A. Thomson.

MISSING.—Flt. Sgt. B. P. Bennett; F/O. E. A. Fayle; F/O. J. R. Hutchins; Flt. Sgt. N. J. Randell.

Royal Canadian Air Force

KILLED IN ACTION.—W/O. R. J. Dickie.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. W. K. Ferguson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. C. M. Bingham; Flt. Sgt. C. A. Brown; P/O. V. M. Byers; Flt. Sgt. W. M. Comba; Flt. Sgt. G. R. Connor; F/O. R. L. Coulter; W/O. L. E. Daw; Sgt. L. W. J. Dawson; P/O. R. H. Dose; F/O. A. B. C. Durnell; F/O. T. A. Fillingham; P/O. A. G. Fletcher; P/O. J. L. Fletcher; F/O. H. W. Fowler; P/O. W. J. Irwin; Flt. Sgt. R. C. Jordan; Flt. Sgt. J. W. Kucinsky; Sgt. J. M. Leblanc; F/O. J. D. Lemare; F/O. H. W. McDonald; Flt. Sgt. D. W. MacFarlane; Flt. Sgt. R. E. Murdock; Sgt. L. J. C. Murphy; Flt. Sgt. J. M. B. O'Connor; F/O. D. H. Orr; P/O. F. J. Piper; W/O. E. S. Pollon; F/O. D. Pratt; P/O. P. Pynisky; Flt. Lt. A. C. Raine; F/O. J. L. Rawson; Flt. Sgt. W. J. Reddie; Flt. Sgt. J. L. R. Renaud; Sgt. D. G. Richardson; Sgt. F. Ruzycki; Flt. Sgt. C. H. Sinclair; Flt. Sgt. L. F. Sparling; Flt. Sgt. F. L. Trovillo; Sgt. R. E. Williams; Sgt. A. T. Woolhouse.

WOUNDED OR INJURED IN ACTION.—Sgt. B. Krukowski.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. D. Bonokoski.

KILLED ON ACTIVE SERVICE.—F/O. J. M. Matherly.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. C. G. Kernaghan; F/O. H. M. Wygle.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—W/O. F. Gration; Flt. Sgt. S. G. Ward.

FOR AIR
BRAVERY
GEORGIVS VI D:G:BRITT:OMN:REX ET INDIAE IMP:
GEORGIVS VI D:G:BRITT:OMN:REX ET INDIAE IMP:
GEORGIVS VI D:G:BRITT:OMN:REX ET INDIAE IMP:
GEORGIVS VI D:G:BRITT:OMN:REX ET INDIAE IMP:

Distinguished Service Order (Red with blue marginal stripes).

The Victoria Cross (Crimson).

Conspicuous Gallantry Medal (Light blue with dark blue marginal stripes).

Distinguished Flying Cross (Broad, oblique, violet and white stripes).

Distinguished Flying Medal (Narrow, oblique, violet and white stripes).

Air Force Cross (Broad oblique, red and white stripes).

Air Force Medal (Narrow, oblique, red and white stripes).

SERVICE AVIATION

Royal New Zealand Air Force

KILLED IN ACTION.—Flt. Sgt. I. Clark; F/O. T. R. Riwai.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. E. Clarke; Act. Squ. Ldr. A. M. Hobbs, D.F.C.; P/O. J. A. Marson; Flt. Sgt. J. McM. Ryan.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. A. E. West.

South African Air Force

MISSING.—Lt. C. H. Clark; Flt. Lt. J. F. Cowan; Flt. Sgt. J. de Groot; Sgt. R. R. Evert; Flt. Lt. C. K. Hurry; Lt. C. P. Peachey; Capt. J. W. Ross; Lt. N. S. T. L. Seaton; Flt. Lt. A. M. Shepherd; 2/Lt. N. A. Smith; Flt. Sgt. C. Sparco; Flt. Sgt. H. C. Ungerer; Flt. Sgt. G. Van Alphen.

KILLED ON ACTIVE SERVICE.—2/Lt. B. A. Whittet.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Lt. P. J. Lubbe; 2/Lt. S. D. Marshall.

Casualty Communique No. 382

Of the names in this list 148 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—P/O. P. Argyle; F/O. H. A. Z. Barkley; Sgt. C. R. Batchelor; F/O. H. K. Battye; Sgt. D. M. A. Brown; Sgt. W. V. L. Edwards; Sgt. A. Elkington; F/O. J. N. Greville-Smith; Sgt. F. E. Hosgood; Sgt. G. Hulley; Sgt. W. N. Jackson; Sgt. T. G. Leitch; F/O. H. McKay; Sgt. R. Melton; Sgt. P. G. Mottram; P/O. E. J. Murray; Act. Wing Cdr. J. A. Piddington; Sgt. E. S. Sayer; Flt. Sgt. J. H. Smart; Sgt. K. J. Wallbey; Sgt. F. Westhead.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. S. J. Banting; Sgt. M. S. Barnard; P/O. W. H. Fisher; Flt. Sgt. R. G. Gravett; Flt. Sgt. A. C. Harris; Sgt. R. W. Horwood; Sgt. E. L. Jones; Sgt. J. Punter; F/O. W. Seaman, A.F.C.; P/O. J. A. Spencer; Sgt. D. W. Sweet; Sgt. T. F. Watkins; Flt. Sgt. W. I. L. Wilkes.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. F. Backler; Sgt. F. A. Bartlett; Sgt. W. Bell; Sgt. T. Birkby; Flt. Sgt. T. D. Bishop; F/O. G. B. Blunn; Sgt. D. Brown; Flt. Sgt. B. J. Buxton; F/O. W. D. Christie; Sgt. T. Collier; Sgt. L. G. Croft; Sgt. C. D. Curtis; Sgt. J. M. Dalton; Sgt. J. W. Darroch; Sgt. R. H. Deacon; Sgt. T. W. Dixon; Sgt. D. S. Donaldson; Sgt. G. S. Dryden; Sgt. S. A. Errington; Sgt. S. F. Evans; Sgt. R. E. Fincham; Sgt. L. R. Fisher; Sgt. R. W. S. Forsdick; Sgt. J. W. Gale; Flt. Sgt. C. A. Goddard; Flt. Lt. W. A. Gorton; Sgt. S. H. N. Hart; Sgt. H. J. Hawkridge; Sgt. J. A. Hitchins; Sgt. R. J. H. Hitchmough; Sgt. J. Howatson; Sgt. B. Huggan; Sgt. N. J. Huxley; Sgt. C. H. Jacotine; P/O. W. H. James; Sgt. T. Jones; F/O. G. G. Judd; Sgt. S. Knowles; Sgt. J. F. Langley; Sgt. S. R. Long; F/O. T. McCall; Sgt. R. G. McCallum; Sgt. C. MacIntyre; Act. Flt. Lt. G. H. McDougal; Sgt. J. B. McLoughlin; Flt. Sgt. A. A. Mansell; Sgt. A. Marshall; Sgt. K. A. Metcalf; Sgt. C. K. Miller; Flt. Sgt. A. R. Moffatt; Sgt. R. D. Moodie; P/O. H. A. Moore; Sgt. E. E. Nicholls; Sgt. E. R. Norburn; F/O. R. R. W. Peters; F/O. J. K. Piry; Flt. Sgt. M. C. Prout; Sgt. R. Reid; Sgt. W. A. Sewell; Sgt. H. H. Sharpe; Sgt. R. S. Shaw; Sgt. P. A. Smith; Sgt. J. H. W. Snowdon; Sgt. M. W. Stevenson; P/O. R. C. Tucker; Sgt. N. Waddington; Sgt. W. A. Wells; Flt. Sgt. G. A. Westthorp.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. Bayliss; Sgt. G. Hobby; F/O. J. C. Keighley.

MISSING.—Sgt. K. A. Archer; Sgt. W. Ashurst; Sgt. W. E. Brown; Sgt. R. A. Campbell; Sgt. G. H. Carpenter; Sgt. R. T. Charles; Sgt. K. E. Clark; Sgt. J. P. V. Cole; F/O. P. J. Coleman; Sgt. K. L. Cragg; Flt. Sgt. G. A. Dinham; Flt. Sgt. S. W. Downes; W/O. E. T. Edwards; P/O. E. G. Forde; Sgt. J. R. Forder; Sgt. W. D. French; Sgt. A. C. Grems; Flt. Sgt. N. Hall; Sgt. R. E. Hall; Sgt. J. W. Harry; Sgt. A. R. Hodson; Sgt. J. T. Hollow; Sgt. D. L. Jones; Sgt. C. F. Lewis; Sgt. F. R. Lewis; Flt. Sgt. R. H. Little; F/O. J. F. McLean; Sgt. V. H. Mate; F/O. W. H. C. Pateman; Sgt. F. J. Pearson; Sgt. A. Pestell; Sgt. W. S. Purdie; Sgt. H. R. Reardon; Act. Flt. Lt. R. N. Shard; Sgt. W. J. Summers; Sgt. N. Walton; Sgt. W. K. Watkins; Sgt. E. A. Wilkes; Sgt. J. R. Williams; Sgt. D. Willsdon; Sgt. R. W. J. Wivell; Sgt. T. S. Woodford; Flt. Sgt. R. E. Woodger; Sgt. P. R. Wynde.

KILLED ON ACTIVE SERVICE.—A/C.2 J. S. Baxter; Sgt. C. S. Bibb; W/O. W. H. Clark; LA/C. J. S. Davies; Sgt. G. Davison; Cpl. E. H. Gill; Sgt. R. Harrison; Flt. Lt. R. V. How; Flt. Sgt. R. C. Lysons; Sgt. D. M. McCannell; LA/C. G. S. Mantosh; Flt. Sgt. H. B. Mitton; Sgt. J. Moakes; A/C.2 J. E. Petterson; Cpl. T. Powell; F/O. E. G. Renshaw; Sgt. J. E. Sawford; Sgt. J. J. Shanahan; Sgt. R. G. Stroud; Sgt. H. R. Taylor; Sgt. A. A. Wardell; Sgt. H. Westell.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. D. Drury.

WOUNDED OR INJURED ON ACTIVE SERVICE.—LA/C. M. Choak; Flt. Sgt. E. F. Freeman; Flt. Sgt. K. A. Henderson; F/O. A. W. Manson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—LA/C. F. R. H. Tibbenham.

DIED ON ACTIVE SERVICE.—Flt. Lt. H. C. Blackwell; A/C.2 J. C. Brooks; LA/C. F. G. Cornwell; Sgt. W. B. Mansell.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—P/O. W. L. Martin; Sgt. W. A. Payne; F/O. J. E. W. Teager.

FULL-TIME JOB: R.A.F. and W.A.A.F. personnel packing chutes for paratroops.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Sgt. E. E. McGilvery; Flt. Sgt. J. H. Paton; Flt. Sgt. W. K. Wood.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. R. Croxton-Davis; Flt. Sgt. A. J. Galley.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. B. W. Bennett; P/O. L. F. J. Brown; Flt. Sgt. E. E. Burton; Sgt. W. N. Cross; Sgt. J. E. Flecknoe; F/O. M. A. Harland; F/O. G. C. Sharp; Flt. Sgt. J. B. H. Smith; Flt. Sgt. D. P. Speechley; Flt. Sgt. W. H. Teede; Flt. Sgt. M. B. Watt.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. W. S. Wilson.

MISSING.—F/O. L. A. Caldow; F/O. R. M. Jacombs; Flt. Sgt. C. H. Martin; Act. Flt. Lt. C. J. Martin; Sgt. A. F. Mason; Flt. Sgt. R. D. Murdoch; Flt. Sgt. E. M. S. Norris; W/O D. R. Rayner; Flt. Sgt. A. H. Sawtell.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. C. D. Bird; Flt. Sgt. S. E. Christie; Flt. Sgt. G. Macoun; Flt. Sgt. W. V. Manuel.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—P/O. D. A. Crookston; P/O. J. W. Evans.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. B. Downey; W/O. J. B. Fowler; Sgt. D. W. Remole; Flt. Lt. A. L. Sanagan; F/O. A. L. Sommerville; W/O. L. L. Whale; F/O. Z. J. Zabek.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. F. G. Maheu.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. C. R. Andrews; Flt. Sgt. W. E. Armstrong; Flt. Sgt. R. W. Billing; F/O. G. R. Bousfield; P/O. G. P. Bray; W/O. J. G. Breen; F/O. A. B. Clegg; Sgt. A. D. Deane; Sgt. H. E. Eddy; Flt. Sgt. C. E. Ferro; W/O. J. J. A. Guay; P/O. F. W. Hodge; Flt. Sgt. D. A. Hogg; Sgt. C. R. D. Hurley; F/O. H. B. Lancaster; Flt. Sgt. E. J. Lewis; Flt. Sgt. J. H. McClung; F/O. J. S. MacIntyre; Flt. Sgt. M. H. Moore; Flt. Sgt. R. S. Morley; F/O. L. R. Nussbaum; F/O. P. Opurk; Sgt. F. R. Pilon; Sgt. L. K. Plank; F/O. R. W. Potts; Flt. Sgt. G. V. V. Reid; Sgt. F. D. Roberts; Sgt. C. M. Smith; F/O. J. R. Spaetzel; P/O. W. H. Taylor; F/O. J. A. Wann.

MISSING.—P/O. J. J. Blanchard; Act. Sqn. Ldr. F. E. Carter; P/O. D. G. Goodfellow; P/O. S. D. Jenkins; W/O. J. D. McIntosh; F/O. W. H. McPherson; F/O. R. C. Parry; P/O. W. E. Rood; W/O. J. N. L. Roy; F/O. R. M. Rumble; Flt. Sgt. A. H. Stockton; W/O. D. V. Walker; P/O. J. W. Wheeler.

KILLED ON ACTIVE SERVICE.—W/O. J. H. Y. Albert; Flt. Sgt. J. G. D. Aubin; Flt. Sgt. J. B. H. Bienvenue; Sgt. M. J. Craig; P/O. W. E. Dubroy; Flt. Lt. A. R. Dunlea; Sgt. J. O. R. Fleury; W/O. A. H. Goodman; W/O. C. H. Hunter; Sgt. T. J. Karaim; Flt. Sgt. R. H. Matthews; Sgt. J. F. Mayville; F/O. E. F. Morton, D.F.C.; Sgt. R. W. Shields; Flt. Sgt. C. A. Simpson; Flt. Sgt. P. W. Sullivan.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. W. R. Taggart.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—W/O. J. D. H. Arseneaut; Flt. Sgt. S. G. Erickson; Flt. Sgt. R. O. Williston.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. G. Aubrey.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. R. C. Buckley; Flt. Sgt. W. D. Clark; Flt. Sgt. G. Henderson; Flt. Sgt. R. W. Lower; Flt. Sgt. F. G. McKay; F/O. F. D. Matheson; Flt. Sgt. L. Petersen; P/O. D. L. Thompson; Flt. Sgt. P. F. Watson.

MISSING.—P/O. H. H. Bruhns; Flt. Sgt. L. L. Butler.

South African Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—2/Lt. D. T. S. King.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—2/Lt. A. de L. Rousouw.

Official Corrections

Casualty Communiqué No. 379.

Under "MISSING" delete **P/O. W.** H. Liddiard. **Sgt. P. B. McLaughlin, Sgt. B. C.** Stewart, and **Flt. Sgt. J. A. Yeomans.**

Casualty Communiqué No. 380.

Under "KILLED ON ACTIVE SERVICE" for Sgt. E. J. Alter read **Flt. Sgt. E. J. Alter.**

S.A.A.F., under "MISSING" delete 2/Lt. G. R. Cook.

Air Transport Auxiliary

First Officer WILLIAM LIONEL GODWIN, A.T.A., killed whilst ferrying His Majesty's aircraft in England.